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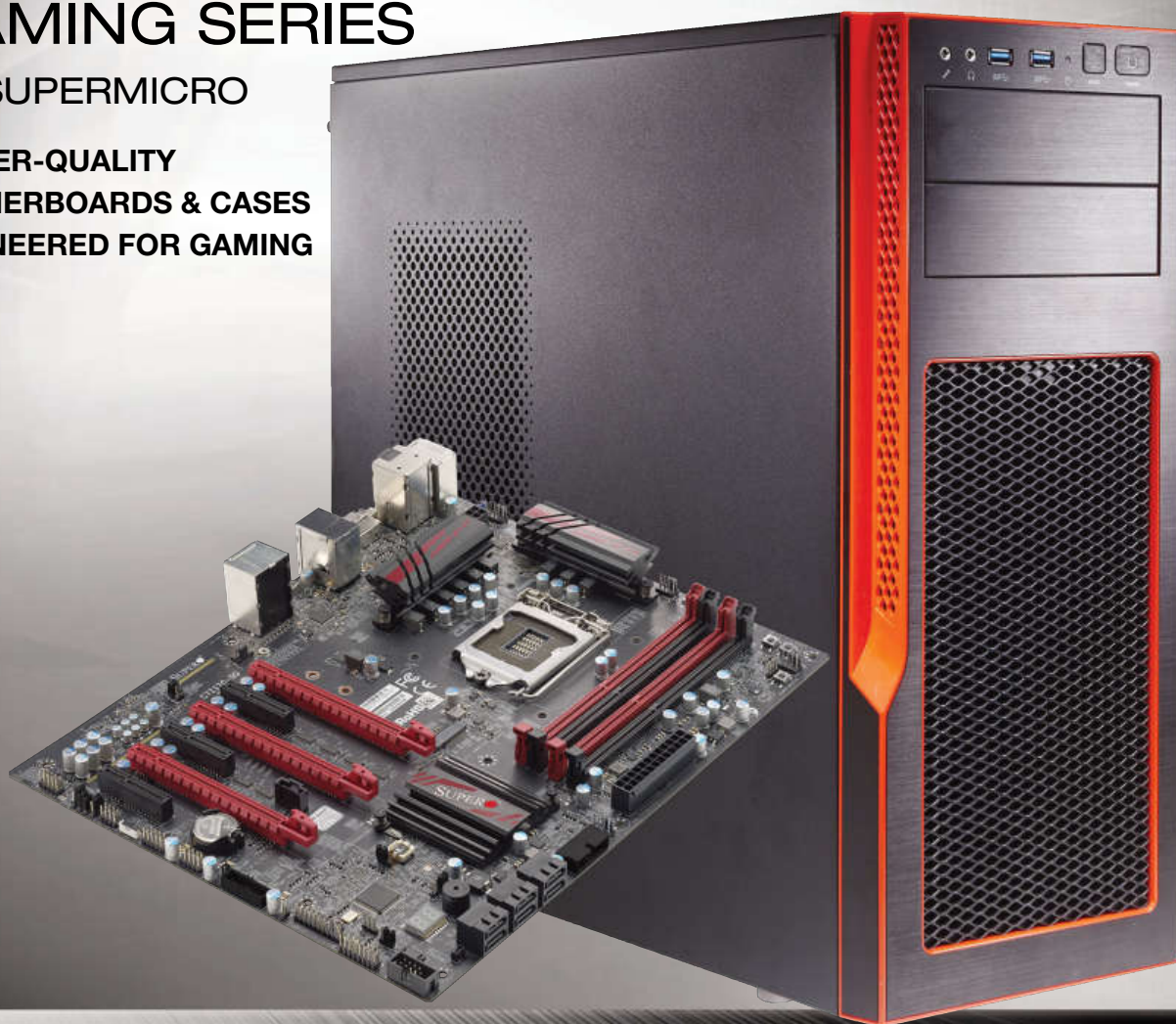
**MAD READER MOD
BS MODS WINS PDXLAN**

SUPER[®] GAMING SERIES

BY SUPERMICRO

**SERVER-QUALITY
MOTHERBOARDS & CASES
ENGINEERED FOR GAMING**

P.12





Make It Yours.

"I AM ALL ABOUT CREATING ON THE FLY, CREATING SOMETHING NEW. I AM A MAKER."



Dave 'drdavient' Cooper 2D GAME DEVELOPER

Dave is a man of many hats. Literally. He splits his time between tech entrepreneurship, game designing, guitar playing and songwriting, university educating, and improvised performance. Dave uses a **MasterCase 5** system for his independent 2D game development and playing needs, but which thanks to the **FreeForm™ Modular System** also offers the flexibility to customize, adjust, and upgrade to meet the demands of whatever catches his fancy in the future.

Learn more about his system and Blockships 2D, an arena combat fight fest game that he's been working on at Coolermaster.com/Dave

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Monthly last-page interview with people who help to shape the PC industry.

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ASUS Has New ROG Motherboard

ASUS launched the ROG Maximus VIII Extreme with eight world records and 12 global benchmarking first places already in hand. The board includes a new OC Panel II with 2.6-inch display for monitoring and tweaking settings such as base clock, fan speeds, and CPU temperature. The panel is meant to sit in a 5.25-inch bay when you're using it mainly to monitor settings, or it can be used as an outside console when you open things up for extreme overclocking and tweaking of your system. The ROG Maximus VIII Extreme includes other ASUS exclusives such as Pro Clock technology, which assists with overclocking base clock speeds for Skylake CPUs, and Extreme Engine DIGI+, which is a voltage regulator module that has dual PWM controllers, black metallic capacitors, and special chokes designed for stable operation when overclocking. The board supports up to 64GB of DDR4 at 3,866MHz (OC) as well as quad-GPU SLI and 4-way/quad-GPU Crossfire, plus it has pro-grade audio components.

AMD R9 Nano Delivers High-Bandwidth Memory To Mini-ITX

AMD has been shaking things up with its new HBM, or high-bandwidth memory, that arrived with the R9 Fury and R9 Fury X GPUs. HBM has a 1,024-bit bus width, and AMD says its new stacked memory delivers more than three times the bandwidth per watt over GDDR5 in just a fraction of the die space. Now the company has announced the R9 Fury Nano, the first GPU that brings R9-level gaming and HBM to Mini-ITX-format systems. The reference card for the R9 Fury Nano is only six inches long, but it's still capable of handling 4K and VR gameplay. AMD bundles the R9 Nano card with one-year licenses for GPU Tweak II overclocking software and Xsplit Gamecaster, a utility and video editor that makes it easy to record and share your gameplay. With the R9 Nano, even small-format systems can have big-time gameplay performance.



WATCHING THE CHIPS FALL

Here is the pricing information for various AMD and Intel CPUs.

CPU	Released	Original Price	Last Month's Price	Online Retail Price*
AMD FX-9590 Eight-Core	6/11/2013	N/A	\$229.99	\$239.99
AMD FX-9370 Eight-Core	6/11/2013	\$375	\$209.99	\$209.99
AMD FX-8350 Eight-Core	10/23/2012	\$195	\$169.99	\$169.99
AMD FX-8320 Eight-Core	10/23/2012	\$169	\$144.99	\$149.99
AMD FX-6350 Six-Core	4/30/2013	\$132	\$129.49	\$126.99
AMD A10-7850K Quad-Core	1/14/2014	\$173	\$129.99	\$129.99
AMD A10-7800 Quad-Core	7/2/2014	\$153	\$124.99	\$126.99
AMD A10-7700K Quad-Core	1/14/2014	\$152	\$121.99	\$121.99
AMD A10-6800K Quad-Core	6/4/2013	\$142**	\$143.89	\$143.49
AMD A10-5800K Quad-Core	10/2/2012	\$122**	\$89.99	\$89.99
Intel Core i7- 5960X Eight-Core	8/29/2014	\$999**	\$1,049.99	\$1,049.99
Intel Core i7- 4960X Six-Core	9/3/2013	\$990**	\$1,029.99	\$1,029.99
Intel Core i7- 5930K Six-Core	8/29/2014	\$583**	\$579.99	\$584.99
Intel Core i7- 4930K Six-Core	9/3/2013	\$583**	\$616.99	\$604.00
Intel Core i7- 5820K Six-Core	8/29/2014	\$389**	\$389.99	\$389.99
Intel Core i7-6700K Quad-Core (Skylake)	8/5/2015	\$359**	\$359.99	\$369.99
Intel Core i7-4790K Quad-Core	6/25/2014	\$339**	\$339.99	\$339.99
Intel Core i7-4820K Quad-Core	9/3/2013	\$323**	\$329.99	\$329.99
Intel Core i7-4790 Quad-Core	5/11/2014	\$303**	\$309.99	\$309.99
Intel Core i5-6600K Quad-Core (Skylake)	8/5/2015	\$249**	\$249.99	\$249.99

* As of September 2015

** Manufacturer's estimated price per 1,000

New KM780 Planks From G.Skill

G.Skill has released two new mechanical keyboards that will carry the RIPJAWS name. The RIPJAWS KM780 MX and RIPJAWS KM780 RGB offer a choice of Cherry MX/RGB switches (Cherry Red and Cherry Brown for now, but the company says Cherry Blue is coming later) and include extra hotkeys and macro control features aimed at serious gamers. Both boards offer on-the-fly macro recording and mode keys that are easy to access, so you can customize keyboard shortcuts for your favorite games and save the layouts. The RIPJAWS KM780 MX is available online for \$119.99. You can find the RIPJAWS KM780 RGB, which offers multi-color adjustable lighting modes, online for \$159.99.



EKWB Intros First MSI Monoblock

Slovenia-based EK Water Blocks has created its first monoblock for MSI motherboards. The company announced its new EK-FB Z170G Monoblock, which is designed for MSI Z170A Gaming M7 series motherboards. The monoblock's base is made of nickel-plated copper, and users can select either acrylic glass or POM Acetal for the top. The monoblock covers the entire LGA 1151 socket area, including the adjacent MOSFET module. EK says its new release is a "very high-flow water block" that will provide cooling protection even with systems that have weaker water pumps. The new monoblock is available online from EKWB for \$136.99.



Lian Li Announces PC-X510 Case

Lian Li has a new case on the way. The PC-X510 is an aluminum mid-tower that compartmentalizes components into three separate chambers to direct airflow and manage temps. The case includes five 120mm fans (three in the front, two in the rear) and a fan controller. The three front fans are mounted on a platform that can be quickly removed (just take out two thumbscrews) to make room for radiators up to 360mm. The PC-X510 measures 620 x 240 x 436 mm (HxWxD). The case has eight expansion slots and also supports up to eight 2.5- or 3.5-inch drives. It comes with a tempered glass side panel. Lian Li says its new PC-X510 chassis will have an MSRP of \$399.



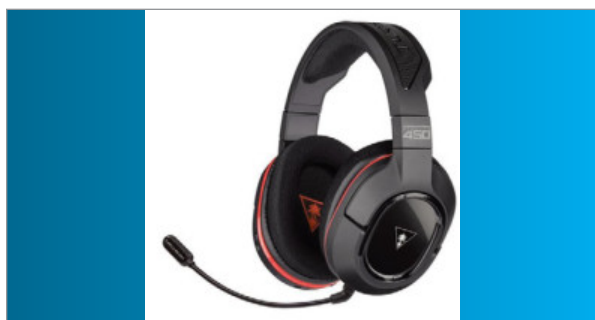
Biostar Announces Hi-Fi H170Z3

Biostar says its new Hi-Fi H170Z3 is the world's first motherboard to offer both DDR3 and DDR4 compatibility, something it can do thanks to the H170 chipset from Intel. The chipset supports 6th generation socket 1151 Intel Core processors as well as USB 3.0, PCIe M.2 (32Gbps), SATA Express (16Gbps), and 4K displays. The Hi-Fi H170Z3 lives up to its Hi-Fi name by including Puro Hi-Fi technology, which has an independent audio power design that includes a built-in amplifier. The separate power delivery reduces the background electronic noise and boosts the signal-to-noise ratio for superior audio quality. The microATX Biostar Hi-Fi H170Z3 has an MSRP of \$104.99.



Turtle Beach Says Its Stealth 450 Gaming Headset Is Best In Class

Turtle Beach's latest headset, the Ear Force Stealth 450, combines DTS Headphone:X 7.1 surround sound, Superhuman Hearing, and other great features into an all-wireless gaming headset. Those extra features include simple setup with one USB connection; 100% fully wireless operation for interference-free wireless gaming; DTS 7.1 surround sound; Superhuman Hearing to ensure you don't miss a sound; variable mic monitoring; audible voice prompts; a high-sensitivity adjustable boom mic; and a 15-hour rechargeable battery, all for just \$129.95.



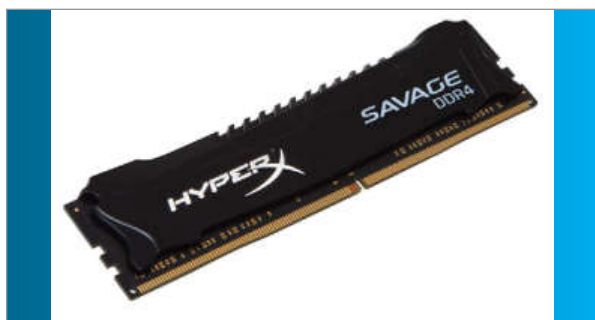
MSI & Corsair Announce New Card

MSI and Corsair have joined forces to create a GeForce GTX 980Ti card using both liquid and air cooling. The card is being branded by MSI as the GTX 980Ti Sea Hawk and by Corsair as the Hydro GFX. This latest addition to MSI's Hawk family uses the Corsair H55 closed loop liquid-cooling setup. With it, a micro-fin copper base efficiently transfers heat to a high-speed circulation pump. A low-profile aluminum radiator uses what MSI says is a "super silent" 120mm fan that varies speed depending on the GPU temperature. The new GTX 980Ti card also has a ball-bearing radial fan with a custom shroud design. Corsair says its version of the card will be available in October for \$739.99.



Kingston's HyperX Launches Savage DDR4 Memory Line

Kingston Technology's HyperX division, which produces products aimed at computing enthusiasts and gamers, has announced a new line of DDR memory called HyperX Savage. The new memory comes in five speeds: 2,133MHz, 2,400MHz, 2,666MHz, 2,800MHz, and 3,000MHz. Single stick sizes are 4GB and 8GB, while kits are available in capacities ranging from 8 to 64GB. The memory features CAS latency of 12 to 15 and voltages of 1.2 or 1.35V. Kingston says Savage memory is compatible with all X99, Z170, H110, H170, and B150 chipsets.



CRYORIG Releases Slim M9 CPU Coolers For Enthusiasts On Budgets

CRYORIG has come out with its smallest tower cooler to date, the M9, which stands less than 125mm tall. The M9 is an entry-level (read inexpensive) product that still has the same materials and technologies found in CRYORIG's other products, including a True Copper base plate and CRYORIG's proprietary Jet Fin Acceleration System, which the company says makes the M9 more efficient at moving heated air. The M9 comes in two versions: M9i, for Intel 115x sockets, and M9a, for AMD FM1, FM2/+, AM2/+, and AM3/+ sockets. The M9 has a TDP of 120W and costs just \$26.99.



App Lets You Send Encrypted Texts

Do you have confidential messages you want to send via text but don't want to risk the chance of anyone else being able to read or decipher the messages? Black SMS takes your text messages, encrypts them, and then hides them inside black bubbles, links, and fake replacement text. To send a text using the app, simply tap Create Message and pick a contact. Enter your secret message and optional fake replacement text that others will see, then enter a password that you've shared with the recipient. To receive a text, copy the fake text into Black SMS and tap Reveal Message. Black SMS uses 256-bit AES encryption, and the app doesn't store information either locally or remotely, it simply encrypts your message with a password. The app is free for a limited time.



Group To Work On Next-Generation Interoperable & Open Media Formats

The Web is a treasure-trove of media clips, live video streams, and other resource-intensive video, audio, and imagery. But the ways those files are compressed, streamed, transmitted, and displayed are inconsistent (and potentially costly). That's why industry leaders Amazon, Cisco, Google, Intel, Microsoft, Mozilla, and Netflix have formed an open-source project for developing next-generation media formats, codecs, and technologies. The Alliance for Open Media is initially working on a video format that is optimized for the Web; scalable to any modern device at any bandwidth; and capable of high-quality, real-time video delivery.



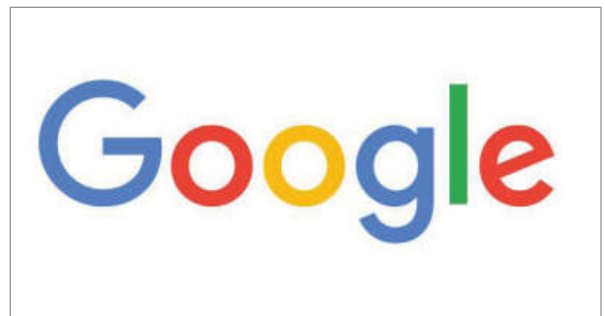
Auslogics BoostSpeed Identifies Problems To Help Optimize Your PC

When your PC is running slow and you're not sure what's causing it, you could try tweaks on your own, download a few different utilities that might do one thing really well, or turn to a more all-encompassing product such as Auslogics BoostSpeed. The newest version, 8, has more than 100 improvements from previous versions. Offline defragmentation, a System Advisor tool that provides advice on what else you can do to improve your PC, and a less restrictive free trial are among the new features you'll find in BoostSpeed 8. It also includes more than 15 easy-to-use PC maintenance tools.



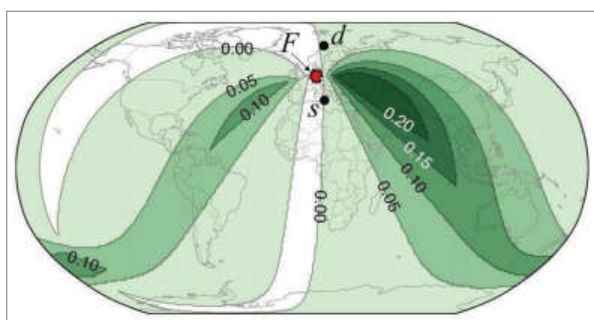
Google Docs Adds New Features, Including A Voice Typing Tool

Google Docs' new Voice typing tool lets you record everything from a simple note to an entire paper. To get started, the next time you're using Google Docs, simply activate Voice typing in the Tools menu. When you're on the go, tap the microphone button on your phone. Google says the feature is available in more than 40 languages. Google Docs has several other new features, including a Research tool that lets you search Google without leaving Docs, a See New Changes feature that will let you pick up where you left off, and a Forms feature to help you conduct surveys or gather responses from a group.



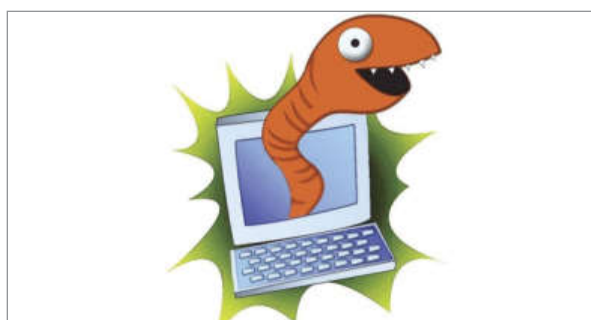
Research Aims To Provide Control Over Where Internet Packets Go

Right now, you have little to no control over where your Internet packets traverse. But that could soon change. Researchers at the University of Maryland, University of Pennsylvania, and other institutions are working on a peer-to-peer system called Alibi Routing that will let you control where your Internet packets don't go, according to researchers. Simply enter a destination and any geographic regions you want to avoid, and Alibi Routing will search its peer-to-peer network of "alibis" to find alibis that can relay packets while avoiding the regions you want. If Alibi Routing for your data is successful, it will send you proof.



Blue Coat Report Identifies Web's "Shadiest Neighborhoods"

My how the Web has grown. Back in the day, you had to look pretty hard to find a site serving as a front for some form of malicious activity. Unfortunately, it's becoming easier to do just that, and a report from Blue Coat shows just where you'll most likely find it. "Due to the explosion of TLDs in recent years, we have seen a staggering number of almost entirely shady Web neighborhoods crop up at an alarming rate," says Dr. Hugh Thompson, CTO for Blue Coat Systems. The five TLDs with the highest percentages of shady sites are .ZIP, .REVIEW, .COUNTRY, .KIM, .CRICKET.



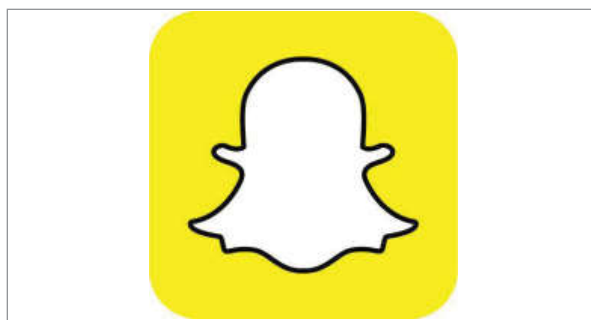
Watch Out, Siri & Cortana, There's A New Kid In Town

Facebook is taking the digital assistant market to a whole different level with its new service. Called, rather succinctly, M, the new personal digital assistant will operate inside of Facebook Messenger to find information on your behalf, according to a blog post by David Marcus, Facebook's vice president of messaging products. Unlike other assistants, though, M will be able to actually complete tasks for you, such as purchase items and book reservations, travel, appointments, and more, he says. Right now, M is being tested by a select group of folks.



Snapchat Now Lets You Pay To View Messages Again

Have a Snap or two or 12 that you want to see just one more time? A new feature in Snapchat—the company that built its service on the premise that messages disappear after they're viewed—lets you do just that. For the past couple of years, the service has offered chatters a chance to replay one Snap per day free of charge. Now, Snapchatters in the United States can purchase Replays starting at three for 99 cents. In a blog post, Snapchat says, "A Replay is like a compliment! So why stop at just one?" With the new offering, you can replay any Snap you receive, but you can only replay a Snap once.





Job Of The Month

LinkedIn is the world's largest professional networking site, with more than 380 million registered members spread across the globe. Those members generate a whole heap of data. The company is currently looking for a senior database engineer to be part of its database engineering team, which helps keep operations running smoothly across its massive information network. Candidates must have a B.S. or B.A. in a technical field, or the demonstrated equivalent experience. They should have 5+ years of experience working in an Oracle environment (10gR2, 11gR1/R2, 12c) and at least a couple of years scripting with Python, Perl, or Shell (and some knowledge of MySQL or Oracle Golden Gate or CouchBase, too). The more you know about supporting high QPS databases, the better. You need to be able to see the big picture and be a hands-on type of problem solver. This particular opening is for Sunnyvale, Calif., but if you desire to live elsewhere, check the site, as LinkedIn has offices worldwide.

Source: www.linkedin.com/jobs

Energy Storage Tech Becoming Big Business

Renewable energy from sources such as wind farms and solar power is helping turn the energy storage industry into big business. In the past year, several companies have introduced battery storage products for industrial use and for the home, with Tesla in particular making headlines for breaking ground on the world's largest factory for lithium-ion batteries. Companies that install energy storage systems and integrate them into existing power networks also are growing. Navigant Research now estimates that annual revenues from installed energy storage enabling technologies (software, control systems, and related services) will reach \$21.5 billion by 2024.

Source: [Navigant Research](#)



Got Tunes?

Of all the industries disrupted during the digital age, music has probably changed as much as any. Radio and vinyl have largely been supplanted by Internet and streaming. Today, some 75% of people in the United States say they listen to their music the newfangled way: by getting it online. Streaming services are becoming more popular, too, but not everyone subscribes. Below are the top reasons people give for subscribing to a particular service or deciding not to subscribe to one.



Top Reasons For Selecting A Streaming Service

- | | |
|-----------------|-----|
| 1. Cost | 83% |
| 2. Ease Of Use | 82% |
| 3. Song Library | 73% |

Top Reasons For Not Subscribing To A Service

- | | |
|-----------------------------------|-----|
| 1. They are too expensive | 46% |
| 2. I can stream music for free | 42% |
| 3. I won't use the service enough | 38% |

Source: [Nielsen Research](#)

RAW Numbers:

50%

Percentage of U.S. consumers who are under the age of 35, have higher-than-average income and education, and expect to buy some type of smart home device in the next 12 months.

[Parks Associates](#)

75%

Percentage of people in the United States who say they now listen to music online. That's out of 91% of the population who reports listening to music, period. (See more data under the "Got Tunes?" item in column one.)

[Nielsen Research](#)

85%

Percentage of parents in a study conducted jointly by Gallup & Google who said computer science education is now just as important for students as core education courses such as math and English.

[Gallup](#)

30 million

Number of virtual reality headsets forecast to be sold annually by the year 2020. During 2016, only 3 million VR headsets are forecast to be sold. The tremendous growth in VR is being driven primarily by the gaming and video segments.

[Juniper Research](#)

\$1.8 billion

The combined value of 3D printers, supplies, and related 3D products and services that were sold during the first half of this year. The market for 3D printing and services is expected to reach \$20.2 billion by 2019.

[Canalys](#)

100%

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SUPER[®]

Supermicro's New Gaming Series Brings Server-Grade Reliability & Stability To Gaming PCs



You've likely heard the name "Supermicro" mentioned in conjunction with mission-critical servers for business applications, and with good reason. The company's server/storage products have a reputation for providing efficient, reliable service in industries where downtime just isn't acceptable, and in recent years Supermicro has engineered those same benefits into a growing line of board, chassis, and server solutions focused on the desktop and gaming market space.

The company launched gaming motherboards to coincide with Intel's Haswell and Haswell-E launches, and now is releasing an entire series of Z170 boards designed for the fastest, most efficient, most stable performance you can get from Intel's Skylake CPUs. Supermicro is also doubling down on its commitment to the gaming community by creating a new brand that encompasses all of its gaming motherboards and cases—SuperO.

What Is SUPER[®]?

"As a natural evolution of our rapidly growing business, Supermicro is positioning SuperO to include our desktop gaming

product lines in the end-user market while maintaining continuity with our roots as a server company," says Supermicro Product Director Barry Huang. "SuperO stands for design superiority with best-in-class quality, reliability, and stability benefits from the Supermicro corporate mission to build the most energy-efficient products."

The new line includes Supermicro's previously introduced C7X99-OCE motherboard, as well as the entire new line of Z170 boards (the C7170-OCE, the C7170-SQ, and the C7170-M) and an H170 board (the C7H170-M) for prosumers.

Of course, every good gaming rig needs an appropriate case, and SuperO has you covered in that regard, as well. The company's S5 and 732G mid-tower cases are designed with the looks and configurability that DIY builders in general—and gamers in particular—look for in chassis for their rigs.

Server DNA

Lots of companies talk about how reliable their products are, but Supermicro has been

proving its claims for more than 20 years in server rooms around the world. So when the company says its motherboards have "server DNA," it's more than just a clever tagline.

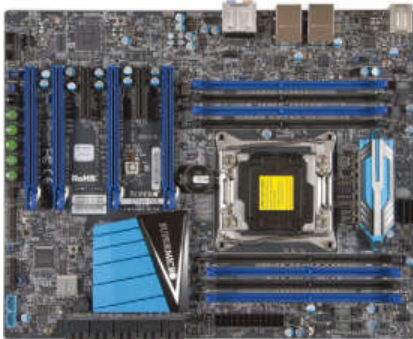
Server DNA means Supermicro's SuperO motherboards are built using extra-layer PCBs with materials that meet server standards for signal integrity. It means these boards' 15μ gold plating on PCIe sockets, connectors, and CPU sockets is 7.5 times greater than the standard 2μ design. It means Supermicro uses only the best Japanese NPCAP solid-state capacitors with longer lifecycle ratings and extremely low ESR that offer outstanding ripple rejection. And it means that Supermicro tests its boards under full loads for 150-plus hours, including tests for extreme workloads, memory use, thermal loads, clock speeds and voltages, and more before validating them.

The results are obvious: A Supermicro SuperO motherboard will provide you with exceptional stability, especially when you push your components to their speed and thermal limits through overclocking. It will also give you the most energy-efficient performance possible, thanks to

better DC voltage regulators, relentlessly refined power signals, precisely optimized signal traces, and advanced power management features.

Meet The Family

Supermicro segments the SuperO line's five motherboards into three subcategories. At the top, the Pro Gaming segment



Supermicro C7X99-OCE

(designed with enthusiasts and power gamers in mind) consists of the C7X99-OCE and the C7Z170-OCE. The C7X99-OCE is, as its name implies, an X99 Haswell-E board designed to support Intel's Core i7-5960X, Core i7-5930K, and Core i7-5820K processors. It comes fully loaded with four PCIe x16 slots, 10 6Gbps SATA ports, and support for up to 64GB of DDR4 at speeds up to 3300MHz.

The C7Z170-OCE is SuperO's flagship Skylake motherboard, and has the same



Supermicro C7Z170-OCE

memory support as its older X99 sibling. It sports three PCIe x16 graphics card slots that run at 16/16 speeds in dual-GPU

configs and at 16/8/8 speeds in 3-way SLI or CrossFire. It packs six 6Gbps SATA ports and also comes with an M.2 port for your next-gen storage needs. And speaking of next-gen support, the C7Z170-OCE also features two available USB 3.1 ports, one of which is the reversible Type C port. The board also boasts a full suite of overclocking tools, including three one-touch overclocking preset buttons, a button for overclocking your memory, an OCE control panel header and diagnostic LED, and buttons for blocking dual boots and for restoring



Supermicro C7Z170-SQ

your BIOS from a USB flash drive (the latter works with any USB port on the board).

The Core Gaming segment (built for mainstream performance gamers) comes next, and it includes the C7Z170-SQ (the handsome red board featured on this month's cover) and the C7Z170-M. The C7Z170-SQ is a Skylake board with support for up to 64GB of DDR4-3200+ memory, three PCIe x16 slots (full x16 speed in single-GPU configs, 8/8 speeds in dual-GPU



Supermicro C7Z170-M

setups, and 8/4/4 speeds in 3-way SLI or CrossFire), similar SATA and M.2 support as the C7Z170-OCE, and all of the C7Z170-OCE's overclocking features except the one-touch preset overclocking buttons. You even get a USB 3.1 Type C port for next-gen connections to all manner of peripherals.

The C7Z170-M is a micro-ATX version of the C7Z170-SQ for value-conscious gamers that has the same memory support but gives up a couple PCIe slots and some USB connectivity in exchange for its diminutive size and potential for increased system portability.



Supermicro C7H170-M

The final segment of the SuperO line is the Core Business line, which currently consists solely of Supermicro's C7H170-M. This board, built around Intel's H170 chipset, is a Skylake board that supports up to 64GB of DDR4-2133 memory but otherwise comes with many of the same features as the C7Z170-M, and is designed for 24/7 business use.

Born To Run

As you can see, SuperO means more than motherboards that look good (although they certainly do); it means boards that you can rely on to perform at peak levels consistently for years to come, even when you overclock your components to their limits.

And thanks to the SuperO line of Supermicro desktop solutions, you can get it with a variety of feature sets at a variety of price points and in both the ATX and mATX form factors. In short, SuperO is the name to look for, no matter what type of gaming rig you are building. (For more information, visit www.supermicro.com/Gaming.) ■

MSI Z170A GAMING M7

Last month, we looked at MSI's Z170A XPOWER GAMING TITANIUM EDITION, which is the flagship model for MSI's Z170 GAMING lineup. The Z170A GAMING M7 comes with many of the TITANIUM's critical performance features, including its DDR4 Boost technology (allows for DDR4 clocked at up to 3,600MHz), support next-generation storage (two M.2 ports and two SATA Express ports), and high-fidelity onboard audio via Audio Boost 3. The Z170A GAMING M7 doesn't have all the overclocking goodies found on the TITANIUM flagship, but it does come with voltage check points, a debug LED, and a Clear CMOS button on the rear panel, so it's no slouch when it comes to overclocking convenience.

The Z170 chipset is the first mainstream chipset to support DDR4, and MSI wastes no time in supporting high-speed DDR4 on the Z170A GAMING M7. To do so, MSI breaks away from the conventional memory signal layout by using optimized traces that fully isolate the memory circuitry from other PCB signals. The design reduces the chance that memory signals are distorted by electromagnetic interference. MSI also makes it easy to know if you've loaded an Intel XMP setting, as an XMP LED near the memory modules will shine brightly once XMP is activated.

The Z170A GAMING M7 also includes components to optimize CPU reliability and improve your overclocking prowess. MSI's Military Class 5 power handling hardware can be found throughout the board. Military Class 5 is highlighted by new Titanium Chokes that offer a higher temperature limit, longer life cycle, and more efficient power transfer than Super Ferrite Chokes,



according to MSI. The Z170A GAMING M7 also includes MSI's Game Boost technology that makes it easy to dial in an intended CPU speed, up to 5GHz.

MSI's GAMING motherboards have always come with premium networking and audio, and the Z170A GAMING M7 takes these features a step further. For connections with the lowest latency possible, MSI includes its GAMING LAN technology, which is a collection of components and software that let you assign application priority and accelerate network traffic to your favorite games and programs. For instance, the Z170A GAMING M7 comes with Killer's E2400 NIC and MSI's GAMING LAN Manager utility for network traffic control. The LAN port itself is shielded by 15KV anti-surge protection, so lightning strikes and static electricity won't fry the board via the Ethernet connection.

MSI introduced Audio Boost 3 this summer, and it features many of the premium-quality audio components found in the previous Audio Boost editions. The biggest difference is that the audio hardware is powered by Nahimic Sound Technology to enhance the audio and deliver virtual 7.1 sound. Nahimic's sound utility lets you create profiles for Music, Gaming, and Movies. Within each profile, you can adjust the intensity of bass, reverb, and voice clarity, as well as turn on or off the virtual surround sound. Nahimic's sound effects can also be applied to streaming broadcasts via Xsplit Gamecaster, and MSI includes the utility and provides a one-year license so you can broadcast games like the pros.

The Z170A GAMING M7's rear panel offers a wide variety of I/O connectivity.

Z170A GAMING M7 | \$229.99 | MSI | us.msi.com

There are two USB 3.1 ports; one is a reversible Type-C connector and the other is the standard Type-A port. MSI also includes a BIOS flashback port where you can connect a flash drive with the latest MSI BIOS and update your PC without a CPU or memory installed. The BIOS flashback port will come in handy if you the board's BIOS has crashed, or if you upgrade to a different CPU and find that you need a new BIOS to support it.

The Z170A GAMING M7 also provides two USB 2.0 ports enhanced with MSI's Gaming Hotkey utility. With a keyboard connected to one of the Hotkey ports, you can bind macros, as well as improve performance on the fly by increasing or decreasing the CPU ratio from hotkeys you assign. If you connect a mouse to the USB 2.0 ports, you can also customize mouse settings via the Mouse Master feature of MSI's Gaming App. You can modify the mouse's DPI level and program macros to mouse buttons.

In our benchmark testing, the Z170A GAMING M7 delivered results right around MSI's Z170A XPOWER GAMING TITANIUM. It scored well in the CPU-intensive POV-Ray 3.7 with over 1,900 pixels per second, as well as Cinebench 15 with 882 points. Game testing also went well, as the Z170A GAMING M7 hit over 60fps in Metro: Last Light, Aliens vs. Predator, and Dying Light. PCMark 8's Creative Score of 5829 shows off the motherboard's all-around capabilities.

The Z170A GAMING M7 is a high-end Skylake motherboard that comes with most all of the modern overclocking and I/O connectivity options power users require. MSI also includes some incredibly powerful extras (Nahimic Sound Technology audio processing, Xsplit Gamecaster's broadcasting service, Hotkey ports, and more) that add capabilities power users won't find on many similarly priced motherboards. In short, you get

Benchmark Results	MSI Z170A GAMING M7
3DMark Professional (Fire Strike Extreme)	6310
Graphics Score	6659
Physics Score	11728
PCMark 8	
Creative Score	5829
SiSoftware Sandra 2015	
Dhrystone AVX2 (GIPS)	199.53
Whetstone AVX (GFLOPS)	109.33
Multi-Media Integer AVX2 x32 (Mpixels/s)	400.59
Multi-Media Long-int AVX2 x16 (Mpixels/s)	183.68
Multi-Media Quad ALU x1 (Mpixels/s)	2.14
Integer B/F AVX/128 (GBps, mem bandwidth)	28.65
Floating B/F AVX/128 (GBps, mem bandwidth)	28.79
POV-Ray 3.7 Beta (pps)	1902.17
Cinebench 15 (points)	882
Games (2,560 x 1,600)	
Metro: Last Light (16XAF)	68
Aliens vs. Predator (4XAA, 16XAF)	69.4
Dying Light (Med, AO On, AA On, Vsync Off)	73.3
The Witcher 3 (Vsync Off, Unl. fps, Ultra)	45

flagship functionality without the having to pay the flagship price. ■

BY NATHAN LAKE

Specs: Max memory: 64GB DDR4 (DDR4-2400; Max OC: DDR4-3600); Slots: 3 PCI-E x16, 4 PCI-E x1; Storage: 6 6Gbps SATA, 2 SATA Express, 2 M.2; Rear I/O: 1 DisplayPort, 2 HDMI, 2 USB 3.1 (one Type-C and one Type-A), 6 USB 3.0, 7 USB 2.0, 1 PS/2, 1 optical S/PDIF out, audio I/O, 1 Ethernet, 1 BIOS flashback, 1 Clear CMOS button; Form factor: ATX; Warranty: 3 years

Test system specs: Processor: Intel Core i7-6700K; GPU: ZOTAC GeForce GTX 980 AMP! Extreme Edition; Memory 16GB Crucial Ballistix Sport DDR4-2400; Storage: 240GB Intel SSD 730 Series; OS: Windows 10 Enterprise (64-bit)



GIGABYTE GA-Z170X-UD5

When Intel or AMD releases a new processor, GIGABYTE is on top of it. At the time of this writing, GIGABYTE already has 17 models in its Z170 lineup, including E-ATX, ATX, microATX, and Mini-ITX models. The GA-Z170X-UD5 is a good representation of the additions you'll find on many of GIGABYTE's Z170 mainboards, as it's a mid-range board that includes most of the core GIGABYTE luxuries. This motherboard also features the signature power handling components of GIGABYTE's Ultra Durable lineup. Read on to learn more about what the GA-Z170X-UD5 has to offer.

The GA-Z170X-UD5 is ready for whatever storage and I/O standards will be around in the near future, which we think is a smart design for a motherboard that's intended to be part of your build(s) for years to come. For internal storage, there are two M.2 connectors that each support up to 32Gbps bandwidth. An optional M.2-to-U.2 adapter card is available for those who want to use Intel's 750 Series 2.5-inch drives, for example. The position of the top M.2 connector, which sits above the expansion slots, would be an ideal spot to install the U.2

adapter because it wouldn't get in the way of any add-in cards. Both M.2 connectors support SATA and PCI-E based storage interfaces.

GIGABYTE also supplies the GA-Z170X-UD5 with three SATA Express ports—each of which supports up to 16Gbps of bandwidth. The SATA Express ports are a great use of the Z170 chipset's 20 PCI-E 3.0 lanes, as conventional 6Gbps SATA devices can also be attached to the SATA Express ports. GIGABYTE adds two more 6Gbps SATA ports (via an ASMedia ASM1061 chip), should you fill up the SATA Express ports and need to connect SATA storage devices.

Speedy external data transfer is available via the rear panel's two USB 3.1 ports, which consist of one reversible Type-C port and one standard Type-A port. GIGABYTE is first to feature Intel's USB 3.1 Controller that delivers a maximum bandwidth of 16Gbps, so you'll get the USB 3.1's full 10Gbps on both ports. On the rear panel of the board, the Z170X-UD5 also offers three USB 3.0 ports, two USB 2.0 ports, and a PS/2 port. Thunderbolt support is there, as well, via an internal Thunderbolt header where you can connect a

GIGABYTE add-in Thunderbolt card (card is not included).

For add-on cards, the GA-Z170X-UD5 provides three PCI-E x16 slots and four PCI-E x1 slots. Similar to most other Z170 motherboards, your GPU setup can max out at 2-way SLI (at x8/x8 speed) or 3-way CrossFire (at x8/x8/x4 speed). We'll note that the bottom PCI-E x16 slot shares bandwidth with the bottom M.2 connector, and if you fill up the bottom M.2 slot, the lanes to the PCI-E x16 slot would be unavailable. To help power multiple GPU configurations, GIGABYTE adds a SATA power connector to GA-Z170X-UD5. GIGABYTE suggests that you use the auxiliary PEG power when two or more GPUs are installed.

To improve your overclocking prowess, the GA-Z170X-UD5 comes with GIGABYTE's TURBO B-Clock Tuning IC that allows for linear range adjustment, 1MHz at a time, of the BCLK from 90MHz to 500MHz, rather than the 5% range adjustment of traditional BCLK straps. Quick buttons are available to turn on your PC, reset the computer, and clear the CMOS, while an OC button will load an optimized profile you've setup. Overclockers will also like that voltage measurement points



are available above the DIMM slots. A Main BIOS and Backup BIOS help to protect you from any overclocking missteps that would crash the BIOS.

For high-speed wired networking, GIGABYTE includes two Intel Gigabit LAN ports whose traffic is manageable via the included cFos Speed utility. Network traffic is automatically shaped by cFos Speed, and you can also manually assign priority among applications and games. The GA-Z170X-UD5 supports teaming over the two LAN ports, as well.

A host of helpful GIGABYTE software is available on the included driver disc. CPU readers are likely familiar with GIGABYTE's EasyTune (overclocking tool), @BIOS (BIOS update application), and AutoGreen (lowers PC power when you're away), as the tools have been around for awhile. Cloud Station is a relatively new utility that lets you create a personal cloud where you can share system resources with mobile devices, notebooks, and other DLNA devices. One especially helpful feature of Cloud Station is its ability to back up files from

your smartphone or tablet. To help you quickly load GIGABYTE's utilities, the GA-Z170X-UD5 comes with APP Center, which serves as one place to access any of GIGABYTE's software.

In our benchmark tests, the GA-Z170X-UD5 muscled through with the help of Intel's Core i7-6700K, a ZOTAC GeForce GTX 980 AMP! Extreme Edition, and 16GB of Crucial's Ballistix Sport DDR4-2400. The motherboard posted good marks in almost all of our games and graphics tests, highlighted by a 70.67fps in Metro: Last Light, 74.2fps

in the Dying Light, and 44fps in The Witcher 3. In SiSoftware Sandra 2015 Lite's Memory Bandwidth test, the GA-Z170X-UD5 posted speedy transfer rates of 28.65GBps (Integer test) and 29GBps (Floating test). Scores in CPU-intensive tests also were solid.

The GA-Z170X-UD5 isn't as showy as some of GIGABYTE's overclocking and gaming-centric Z170 alternatives, but as Han Solo said of the Millennium Falcon, "she's got it where it counts." There are great overclocking capabilities, support for high-speed memory, and well-appointed storage connectivity. You get all this for less than \$200, which is a perfect example of GIGABYTE's motherboard expertise paying dividends to power users. ■

BY NATHAN LAKE

GA-Z170X-UD5

\$190

GIGABYTE

www.gigabyte.us

Benchmark Results

GIGABYTE GA-Z170X-UD5

3DMark Professional (Fire Strike Extreme)

Score	6676
Graphics Score	7095
Physics Score	12927
Graphics Test 1	37.51
Graphics Test 2	26.2
Physics Test	41.04
Combined Test	14.33

PC Mark 8

Creative Score	5768
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Cinebench 15

CPU (points)	883
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POV-RAY 3.7 (pixels per second)

	1891.95
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CrystalDiskMark 5.0.2 (MBPS)

Sequential Read (Q32T1)	389.4
Sequential Write (Q32T1)	260.8
4K Read (Q32T1)	271
4K Write (Q32T1)	238.9
Sequential Read	341.2
Sequential Write	295.9
4K Read	33.5
4K Write	97.04

Games

2,560 X 1,600

Aliens VS. Predator (8XAA, 16xAF)	71.1
Metro: LL (16XAF, SSAO off)	70.67
Dying Light (Med, AO On, AA On, Vsync Off)	74.2
Witcher 3 (Vsync Off, Unl. FPS, Ultra)	44

Specs: Max memory: 64GB DDR4 (DDR4-2133; Max OC: DDR4-3466); Slots: 3 PCI-E x16, 4 PCI-E x1; Storage: 8 6Gbps SATA, 3 SATA Express, 2 M.2; Rear I/O: 1 DisplayPort, 1 HDMI, 1 DVI-D, 2 USB 3.1 (one Type-C and one Type-A), 3 USB 3.0, 2 USB 2.0, 1 PS/2, 1 optical S/PDIF out, audio I/O, 2 Ethernet, Form factor: ATX; Warranty: 3 years

Test system specs: Processor: Intel Core i7-6700K; GPU: ZOTAC GeForce GTX 980 AMP! Extreme Edition; Memory 16GB Crucial Ballistix Sport DDR4-2400; Storage: 240GB Intel SSD 730 Series; OS: Windows 10 Enterprise

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Anarchy DDR4-2400 16GB / \$134.99
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PNY Anarchy DDR4-2400 16GB

Last month we took a look at one of PNY's Anarchy X DDR4 kits, so this month we're putting its more affordable sibling to the test. The 16GB Anarchy DDR4-2400 (PC4-17000) kit consists of four 4GB matched modules that will work well in a quad-channel X99 system or in the newly launched Z170 platform as a dual-channel kit.

Like the Anarchy X kit we brought you last month, this kit utilizes eight 512MB x 64-bit SDRAM chips, arranged on a single side. These are 1Rx8 modules, meaning that the eight chips are on a single rank, i.e. they share the same data path. This kit supports Intel's XMP 2.0, but depending on your motherboard, the memory may boot to 2,133MHz by default. Simply go into the BIOS and enable the first XMP profile to begin enjoying all the speed this memory has to offer. At its rated speed, Anarchy DDR4-2400 kit runs at 1.2V. The default timings are slightly tighter than those of the Anarchy X kit, at 15-15-15-36. When testing, we encountered an interesting phenomenon where the kit actually booted with the timings set to 16-16-16-37. It's common with any new platform that there will be quirks that get solved in subsequent BIOS revisions, but

we were able to manually set the timings and move on.

The Anarchy DDR4 kit's heat spreader sports a smoother, less-jagged design compared to the Anarchy X, but it's still a very low-profile bit of black anodized aluminum. From its 288 gold contacts to the top edge of its heat spreader, the module measures just an inch and a half. This makes it easy to add or remove the kit even when you have a large CPU cooler bolted to the back panel of your case. There is a central aluminum plate on the heat spreader that comes in red or blue; the kit we tested wore the blue. The face of the heat spreader features a slate-colored sticker adorned with Anarchy, PNY, and DDR4 labels. PNY backs this kit with a lifetime warranty in the U.S.

In SiSoftware Sandra 2015 SP2, the integer and floating-point memory bandwidth scores were, unsurprisingly, a hair behind those of the Anarchy X kit, at 48.88GBps and 51.1GBps, respectively. In Sandra's memory latency test, the Anarchy kit scored a solid 26.6 nanoseconds. Again, we ran a low-resolution Aliens vs. Predator test designed to isolate the CPU and memory performance, and achieved a compelling 745.7fps, which was just 5fps behind the

Benchmarks	PNY Anarchy DDR4-2400 16GB
SiSoftware Sandra Lite 2015. SP2	
Memory Bandwidth	
Integer Memory Bandwidth B/F AVX2/256 (GBps)	48.88
Floating Memory Bandwidth B/F FMA/256 (GBps)	51.1
Cache & Memory Latency (ns)	26.6
L1D (clocks)	4.7
L2D (clocks)	13
L3D (clocks)	26.6
Cache Bandwidth (GBps)	286.75
L1D (TBps)	1.36
L2 (GBps)	498.2
L3 (GBps)	218.63
Game	
Aliens VS. Predator (Low, 1XAF, No AA, 800 x 600)	745.7fps

Anarchy X kit. To emphasize how important timings are, we decided to run this test using the CL16 settings that the kit originally booted at, and the results shed 19.4fps. The moral of this story? Always run your memory at the proper timings.

The price on this kit, as well as its competitive performance, are two reasons we're recommending PNY's 16GB Anarchy DDR4-2400 16GB kit for new builds or upgrades to existing systems. ■

BY ANDREW LEIBMAN

Specs: Capacity: 16GB (4 x 4GB); Timings: 15-15-15-36; Frequency: DDR4-2400 (PC4-17000); Voltage: 1.2V; Unbuffered; Non-ECC; Warranty: Lifetime
Test system specs: Processor: Intel Core i7-5960X; Motherboard: GIGABYTE X99-Gaming G1; Storage: 240GB OCZ Vertex 3 MAX IOPS SSD;
 OS: Windows 8 Enterprise (64-bit)

**Riing 12 LED RGB**

\$69.99 (three pack)/ \$24.99 (single pack)

Thermaltake

www.thermaltakeusa.com

Thermaltake Riing 12 LED RGB

There's a reason power users gravitate toward systems with big side-panel windows, colorful liquid-cooling loops, and shiny internals. Power-user rigs are often as much art as performance. An attractive, cohesive color scheme is, of course, essential when creating a standout PC, and LED fans are an excellent tool to emphasize a build's color palette and illuminate the system interior.

Thermaltake's Riing 12 LED RGB fan offers a uniform lighting effect via an LED ring that's visible from all directions, which makes the fan's lighting much more distinctive inside a case than fans with LEDs in the corners of the frame. And you can set the RGB LED inside the Riing fan to a gradient that will best match your rig's color scheme, no matter if the look is orange, purple, yellow, or any other non-standard LED fan color.

The Riing 12 LED RGB fan comes with a fan controller that lets you switch colors and manage speeds on the fly. For convenience, Thermaltake includes several preset color modes

for popular hues. Just press the Mode button on the controller to switch among solid red, blue, white, and green LED lighting. If another color is preferred, select the mode that cycles through 256 colors and press the Play/Pause button when the LED displays the color you want. The fan controller has three inputs, and if you connect three Riing 12 LED RGB fans, all three will display the same color. You can also let the fan cycle through the colors or shut off the LED lighting entirely.

The Speed button on the fan controller lets you toggle between the performance and low-noise fan speed modes—both of which feature PWM control. In performance mode, the Riing 12 LED RGB operates between 800 and 1,500rpm, while the low-noise mode runs between 400 and 1,000rpm. When running at 1,500rpm, Thermaltake rates the Riing 12 LED RGB for 40.6cfm and 26.4dBA. Switching to the low-noise mode will drop noise levels by 29%, according to Thermaltake.

Similar to the initial lineup of single-color Riing LED fans, the RGB models are designed to generate high static pressure, and are best situated next to radiators and other places where airflow is restricted. Their fan blades utilize Thermaltake's CCB (Concentrated Compression Blade) design that focuses the weaker inner circle of airflow to the blades' outer section, which creates a compression effect. The blade design makes the Riing 12 LED RGB effective at pushing air through a dense fin array where extra force is necessary to generate airflow.

The CCB blade works in conjunction with Thermaltake's Wind Blocker Frame to further direct airflow towards the pressurized blade area. The inner ridge of the LED ring, in particular, helps to shift air into the middle section of the blade, which creates another compression effect—one that helps to block pressure from escaping. To avoid vibration, Thermaltake adds in-mold injection rubber pads on each corner of the frame.

Thermaltake sells the Riing 12 LED RGB fan in a single pack for \$24.99 and triple packs for \$69.99. You get a slight price break with the three pack, and we imagine those with 240mm and larger radiators will likely want more than one for a consistent look. The Riing 12 LED RGB's style is certainly unique and really does stand out inside a case. The clean, crisp, uniform glow is something that should certainly appeal to enthusiasts who want a showroom interior. ■

BY NATHAN LAKE

Specs: Dimensions: 120 x 120 x 25mm; Speed: 400-1,000rpm (using low-noise cable), 800-1,500rpm; Maximum airflow: 40.6cfm; Maximum air pressure: 2.01mm H2O; Noise: 18.5-26.4dBA; Connector: 4-pin PWM; LED: RGB, 256 colors; Power: 2.52W; Bearing type: Hydraulic

**Core 500**

\$59.99

Fractal Design

www.fractal-design.com

Fractal Design Core 500

The mistake many manufacturers make when crafting Mini-ITX cases is in assuming that price and size are the most important considerations for someone who chooses this form factor. With the Core 500, however, Fractal Design is clearly acknowledging that performance and versatility are very much a priority for SFF users.

The Core 500 is a compact case made primarily from thick SECC steel, painted a matte black inside and out. The plastic front panel is clean save for the 5.25-inch bay that features a removable door. This panel features a plastic insert that mimics brushed aluminum, flanked on either side by narrow black metal mesh panels backed with dust-blocking foam. The top-front edge of the Core 500 features the front panel ports, including a pair of USB 3.0 ports and the audio line-in and mic ports. There's also the power and reset buttons and an HDD activity LED here.

The top and side panels are a single piece of bent steel and there are large

vents on the top and left sides backed by magnetic dust filters. A third dust filter below the PSU bay resides on the underside of the case and slides into a quartet of tabs. The PSU mount is at the front of the case, just behind the front panel, and the motherboard sits at the back. The chassis includes a power extension cable that links up with a standard PSU cable to the left of the motherboard's I/O panel. The two expansion slots on the back panel feature Fractal's signature white slot covers.

Despite the small size, this case can accommodate any combination of two 2.5-inch SSDs and two 3.5-inch HDDs using a unique crossbeam that spans between the front and back panels. The removable drive cage adjacent to the front panel gives you room for another 3.5-inch HDD and a 5.25-inch optical drive or device of your choice. There's space for a third SSD or 2.5-inch HDD behind the front panel. The exhaust fan mount offers enough space to support a 120mm

radiator. Should you choose to forego the ODD bay, you can fit either a 240 or 280mm radiator for a custom or closed-loop liquid cooling setup. Those sticking with air cooling can install up to two 140mm fans in the top panel.

There are rubber grommets for the storage mounting screws to keep vibration noise to a minimum and a pair of foam pads under the PSU perform the same sound-dampening function. This case features a single 140mm exhaust fan, but it's one of Fractal's Silent Series R3 units, which can keep the system cool at a mere whisper. We're a fan of large CPU coolers, and it appears Fractal is too; this case supports coolers as tall as 170mm. There's also enough space behind the ATX-compatible PSU bay for graphics cards up to 310mm in length.

The Core 500 is one of those rare cases that manages to be compact, yet gives you tons of room for extras. ■

BY ANDREW LEIBMAN

Specs: Dimensions: 11.2 x 13.1 x 17.1 inches (HxWxD); Materials: SECC steel, plastic, metal mesh; Motherboard support: Mini-ITX; Drive bays: 3 x 2.5/3.5-inch HDDs/SSDs, 1 x 5.25-inch bay (removable); Fans (included): 140mm exhaust; Ports: 2 x USB 3.0, audio I/O

MSI GTX 980 Ti Lightning



This month, MSI sent us its second take on the GTX 980 Ti, and this one is all muscle. We shouldn't be surprised, after all, MSI's Lightning graphics cards have a reputation to uphold.

But before we dive into what makes this card such a jaw-dropper, let's briefly recap the raw numbers, courtesy of NVIDIA's GM200 GPU. The die sports 8 billion transistors wired into a 601mm² die, manufactured on TSMC's mature 28nm process. Architecturally speaking, there are 22 streaming multiprocessors for a total of 2,816 CUDA cores, 176 texture units, and 96 ROPs. The GTX 980 Ti reference design sports a 250-watt TDP and a pair of 8-pin PCIe power connectors give it the juice it needs. On the Lightning card, however, there's an extra 75-watts of power this card can tap into thanks to the additional 6-pin PCIe power port that resides on the top edge. Despite the bump in available power, the box claims you can run this card with a 600-watt continuous PSU, sufficient amperage on the 12V rail notwithstanding.

We've said it before, but this card is one of the few you can buy that manages competent 4K gaming, and that's thanks in no small part to the GTX 980 Ti's memory subsystem. This card features 6GB of GDDR5 memory running on a 384-bit memory bus, clocked at the stock speed of 1,752MHz. As a Lightning card, you'd better believe it comes out of the box with a hefty factory overclock; the

core and boost clocks have been bumped from 1,000MHz and 1,075MHz, respectively, to 1,203MHz and 1,304MHz. Although Zotac's GTX 980 Ti AMP! Extreme Edition outpaces this card, the Lightning card's factory clock is merely a starting point. That fact is driven home by the inclusion of a special heat plate that you can install and an LN2 mode dip switch built into the PCB.

The TriFroze cooler attached to this card sports three 90mm PWM-controlled fans and a massive heatsink. There's a large black plastic shroud and aluminum plates painted yellow make a stylized "OC" on the face of the card. There's also an anodized black backplate and a series of 8mm copper heatpipes that thread the heatsink and help it dissipate up to a stunning 700 watts of thermal energy. On the board, you'll find MSI's long-life Military Class 4 components, including 12+3 power phases, 60A DrMOS MOSFETS, Hi-C capacitors, Super Ferrite chokes, and dark capacitors. You can tune the RGB LED-backlit Lightning logo on the top edge of the card, but whatever your preference, MSI hopes you like the color yellow; it's all over this card.

As the benchmarks indicate, this card offers excellent performance running even the most demanding games available. Even at the highest resolutions, it doesn't break a sweat and runs quiet. If you like the sound of that, and the potential for achieving even more via MSI's Afterburner software, then the MSI GTX

Benchmark Scores	MSI GTX 980Ti GAMING 6G
Core/Boost Clocks	1,203MHz/1,304MHz
Memory Clock	1,752MHz
Memory Interface	384-bit
Memory	6GB GDDR5
3DMark Professional (Fire Strike Extreme) Score	8611
Unigine Heaven 4.0 Score	2193
FPS	87.1
Games	1,920 X 1,080
Aliens VS. Predator (Very High, 16XAF, 4XAA, SSOA)	155.3
Metro: LL (DX11, Very High, 16XAF, Very High Tess.)	125
Dying Light (High, AO On, AA On, Vsync Off)	171.55
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	98.79
	2,560 X 1,440
Aliens VS. Predator (Very High, 16XAF, 4XAA, SSOA)	97.2
Metro: LL (DX11, Very High, 16XAF, Very High Tess.)	89.67
Dying Light (High, AO On, AA On, Vsync Off)	100.6
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	74.31
	3,840 X 2,160
Aliens VS. Predator (Very High, 16XAF, 4XAA, SSOA)	47.8
Metro: LL (DX11, Very High, 16XAF, Very High Tess.)	48.33
Dying Light (High, AO On, AA On, Vsync Off)	55.36
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	41.63

GTX 980 Ti Lightning is the graphics card for you. ■

BY ANDREW LEIBMAN

GTX 980 Ti Lightning / \$799.99
MSI / www.us.msi.com

Specs: GPU: Maxwell GM200; Core Base/Boost Clocks: 1,203MHz 1,304MHz Boost; Memory Clock: 1,752MHz; Memory Bus: 384-bit; Frame Buffer: 6GB GDDR5; Factory Overclocked: Yes; Ports: dual-link DVI, HDMI, three DisplayPort

Test system specs: Processor: Intel Core i7-5960X; Motherboard: GIGABYTE X99-Gaming G1; RAM: 16GB Ballistix Elite DDR4-2400; Storage: 240GB OCZ Vertex 3 MAX IOPS SSD; OS: Windows 8 Enterprise (64-bit)

ENERMAX

ETS-T40F-W

If you've shopped for CPU coolers in the last few years, you've likely come across some version of ENERMAX's ETS-T40 series. First introduced in 2011, these air coolers typically retail for less than \$50 and provide solid performance to builders looking to upgrade from a stock air cooler. ENERMAX's newest ETS-T40Fit series feature a slimmer heatsink that virtually eliminates the chance the CPU cooler or connected fans will extend over your system memory, and thus, prevent you from using memory modules with tall heat spreaders. The ETS-T40Fit retains the patented heatsink technology, such as VEF (Vacuum Effect) and VGF (Vortex Generator Flow), that have made the ETS-T40 series so effective. Here, we'll go in-depth on the ETS-T40F-W, an all-white cooler that's the best performer in the new Fit lineup.

The four models in the ETS-T40Fit lineup all employ the same slim heatsink, though colors vary by model. The ETS-T40F-W is the Fit series' top dog because it comes with two of ENERMAX's high-performance CLUSTER ADVANCED fans that spin at up to 2,200rpm. The ETS-T40F-W is the only model that includes two fans so you can create a push-pull airflow configuration. Both of the CLUSTER ADVANCED fans support PWM fan speed control and run as slow as 800rpm when your system is idle. In short, you'll have performance when you need it, and near silence when you don't.

For further noise control, the CLUSTER ADVANCE fans feature an APS (Adjustable Peak Speed) switch that lets you reduce the maximum RPM range of the fan. In Ultra Silent mode, fan speeds

will top out at 1,500rpm for a maximum noise level of 17dBA and bring maximum airflow down to 71.3cfm. Selecting the middle setting raises maximum fan speed to 1,800rpms and 21dBA, while also pushing maximum airflow to 86.7cfm. In Performance mode, the 2,200rpm increases noise levels to 27dBA, yet pushes airflow all the way to 105.9cfm. Clearly, ENERMAX makes sure you're in total control of fan noise with the ETS-T40F-W.

The ETS-T40Fit series heatsink is loaded with ENERMAX technologies. Let's start at the base of the heatsink, where the ETS-T40F-W uses Heat Pipe Direct Touch to ensure the four 6mm heatpipes make physical contact with your CPU. Moving up to the aluminum fins, ENERMAX employs its VEF design that prevents cool air from leaking out of the fin structure, so cool air is sure to pass thru and wick heat away from the heatsink. Lastly, ENERMAX's VGF technology creates an airflow effect that moves hot air that would otherwise be stuck behind the heat pipes.

To test the ETS-T40F-W, we installed it in a rig with an Intel Core i7-6700K

and an MSI Z170A GAMING M7 motherboard. First, we let the system idle for 10 minutes, and the ETS-T40F-W produced a maximum temperature of 24 degrees Celsius. Next, we ran POV-Ray 3.7 on all cores for 10 minutes, which increased the maximum temperature to 66 C. Lastly, we ran our most CPU-intensive benchmark, Prime 95's Small FFT torture test, for 10 minutes. The stress test produced a maximum temperature of 74 C. We know that the Core i7-6700K runs much cooler than the Core i7-4790K (experts have found anywhere between three and seven degrees under load), yet even considering this, the ETS-T40F-W's cooling performance is impressive.

We've always admired ENERMAX's innovations in heatpipes and aluminum fins, and on the ETS-T40F-W, the technology has been channeled to a slimmer design. The all-white heatsink and fan combo looks the part in an enthusiast rig and is powerful enough for modest overlocks. It's a good value at \$49.99. ■

BY NATHAN LAKE



ETS-T40F-W

\$49.99

ENERMAX

www.enermaxusa.com

Specs: Materials: Copper (base, heatpipes), aluminum (fins); Fans: 2 x 120mm PWM (800- 2,200rpm max); Cooler dimensions: 6.4 x 3.8 x 5.0 inches (HxWxL); Socket compatibility: Intel LGA775/1150/1151/1155/1156/1366/2011(3), AMD AM2/AM2+/AM3/AM3+/FM1/FM2/FM2+; Warranty: 1 year

Test System Specs: Processor: Intel Core i7-6700K; Motherboard: MSI Z170A GAMING M7; GPU: ZOTAC GeForce GTX 780 AMP! Extreme Edition; RAM: Crucial Ballistix Sport DDR4-2400; Storage: 240GB Intel SSD 730; OS: Windows 10 Enterprise (64-bit)

Double Play

Intel's Haswell-E & Skylake Lineups Offer Power For All

Who is a power user? Sure, it's really easy to point to a \$10,000 gaming PC—complete with a flagship processor, four graphics cards, PCIe SSDs, and all the requisite trimmings—and say, “that guy,” but there's a better answer. We think that being a power user is more a state of mind than a state of hardware. True power users are those who make the most of the hardware available to them.

With a fleet of terrific, cutting-edge CPUs, Intel wants to make power users out of everyone, regardless of budget. Thanks to a pair of processor families, enthusiasts with a passion for pushing their CPUs have plenty of options.

Hail To The King

The undisputed champ of desktop performance continues its reign. The leader of the Haswell-E Dynasty, Intel's Core i7-5960X is as good as it gets. Armed with eight physical cores and Hyper-Threading, the 5960X bulls through demanding workloads 16 instructions at a time. Its 20MB of

Intel Smart Cache is the most you'll find among any of Intel's desktop chips. The 5960X's 3GHz stock clock speed is expected for a processor that boasts so many discrete cores, and it's capable of dialing in a 3.5GHz Turbo frequency for lightly threaded loads.

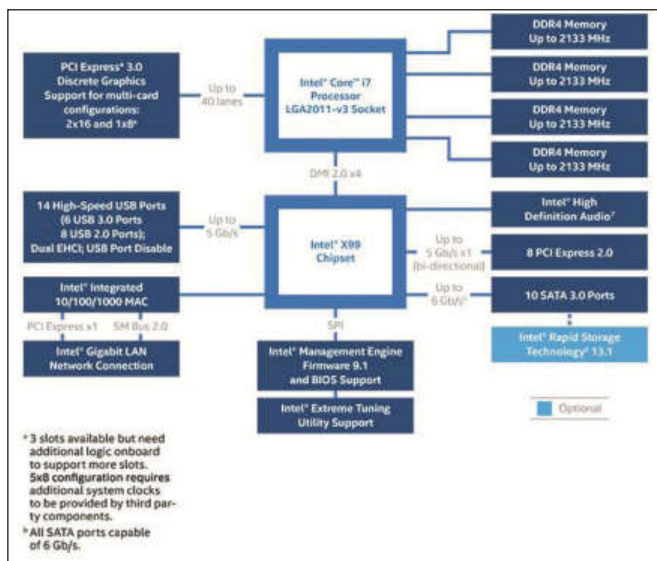
A pair of ruthless six-core processors join the 5960X in formation. The Core i7-5930K and i7-5820K are clocked at 3.5GHz and 3.3GHz, respectively, and as you'll soon find out, there's potential for much higher clocks. Both of these chips are equipped with 15MB of Intel Smart Cache. Like the 5960X, the 5930K and 5820K can use Hyper-Threading to double the number of threads their cores can handle.

Each Haswell-E processor is plenty ferocious out of the box, but industrious power users can roll up their sleeves and unleash the full fury of the silicon. The chips are unlocked to make overclocking easier: Set a higher multiplier and get a higher clock. Of course, veteran enthusiasts know that overclocking still requires a fair amount of skill, but when



you pair a Haswell-E CPU with a capable motherboard and cooler, you have the perfect recipe for maximizing these processors' performance. Thanks to Intel's Extreme Tuning utility, overclocking the 5960X, 5930K, or 5820K doesn't have to be a tedious, excruciating affair. Beginners can use the software to quickly and easily access extra processing horsepower, while experienced overclockers may be surprised at the number of dials and knobs at their disposal when using XTU.

Haswell-E also gives you access to a host of goodies, thanks to Intel's X99 chipset. DDR4 has gone mainstream, true, but the X99 platform truly lets your DDR4 modules shine. Thanks to the Haswell-E processors' integrated quad-channel memory controller, X99 motherboards provide tremendous memory bandwidth, especially after you factor in support for XMP profiles and high-end DDR4 modules that can exceed 4,000MTps (mega-transfers per second).



Advertisement

Gamers also stand to benefit from an abundance of PCIe lanes available to Haswell-E processors. The 5960X and 5930K both have 40 lanes at their disposal, putting a 4-way SLI or CrossFire setup within easy reach. The 5820K is limited to 28 lanes, but that's more than enough for a powerful multi-GPU setup.

Soar With Skylake

In case you haven't been paying attention, Intel recently updated its lineup of quad-core processors, too. Built on a 14nm process and formerly code-named "Skylake," Intel's 6th Generation Core processors are proof that you don't need to refinance your house or put up a kidney for sale on Craigslist to purchase the services of an incredible CPU.

The Core i7-6700K leads the 6th Generation Core family into battle. It's a quad-core processor, but like its Haswell-E cousins, Hyper-Threading lets the chip tackle twice as many simultaneous instructions per core. The 6700K starts with a stock clock of 4GHz, and Intel's Turbo Boost 2.0 can bump that up to 4.2GHz. It includes 8MB of Intel Smart Cache.

Rounding out our gallery of power-user processors is the Core i5-6600K, which has four physical cores, 6MB of Intel Smart Cache, and a 3.5GHz base frequency. With certain workloads, Turbo Boost can jack the 6600K's clocks to 3.9GHz, but the fun really begins when you take advantage of its unlocked multiplier.

Yes, the 6700K's and 6600K's unlocked multipliers are a big part of what make them true power-user processors. Intel has built these chips precisely for enthusiasts who prefer to tinker their way to faster speeds and better performance. K Series Skylake processors let you run the core ratio all the way up to 83X, increasing the resulting clock speed 100MHz at a time.

Going further, these CPUs are bristling with other options for overclockers. There are Turbo overrides for voltage and power, and you can also punch up the BCLK, increasing it in 1MHz increments. With the right supporting hardware, you may be able to push your BCLK to 200MHz or higher. In addition to these changes, the



6700K and 6600K have unlocked voltage controls, which should provide increased stability that ultimately leads to even higher frequencies.

For the first time ever, Skylake CPUs and their accompanying Z170 chipset bring DDR4 support to the masses. Previously, you had to have a HEDT (high-end desktop) processor to take advantage of the high-speed, low-voltage memory, but now mainstream builders can make the move to DDR4, too. Consistent with previous generations of Intel quad-core processors, the 6700K and 6600K have a dual-channel on-die memory controller. Both processors support up to 64GB of DDR4.

Would it surprise you to learn that Intel has also made improvements to that on-die memory controller? Previously, users could only overclock their memory modules by 200/266MHz. Skylake and the Z170 chipset halve that to 100/133MHz, giving much more control to those who like to manually overclock their memory. Naturally, Skylake still gives you XMP support for set-and-forget memory overclocking.

The Future, Sponsored By Z170

Maybe you're just not that into overclocking. It's OK, your secret's safe with us. You should know, though, that Skylake processors and the Z170 chipset have tons of cutting-edge features that don't have anything to do with overclocking. The new DMI 3.0 (Direct Media Interface) connection between the CPU and PCH has four lanes, and each lane delivers bandwidth up to 8GTps. The Z170's beefed-up Flex-IO hub gives motherboard manufacturers the ability to outfit their boards with even more PCIe lanes, USB 3.0 ports, or 6Gbps SATA connectors (now 26 total, almost 50% more than the Z97 chipset's 18). PCIe devices will have access to greater bandwidth through the Z170 chipset, giving next-gen storage drives all the "tubes" they need for breakneck speed. Add Intel exclusives such as Intel Ready Mode Technology, Intel Smart Sound Technology, and Intel Device Protection Technology with Boot Guard, and you have the foundation for a mighty machine that will last a long time. ■

State-Of-The-Art Standards

Thunderbolt 3



Over the years, USB and Thunderbolt have had something of a sibling I/O rivalry, with the speedier Thunderbolt gaining dominion over the data transfer and display needs of professional content creators, while USB took care of business in peripheral connections and everyday data transfer duties for most everyone else. But like any rivalry, escalation is inevitable.

The latest USB standard, USB 3.1, delivers a theoretical maximum bandwidth of 10Gbps, which matches the data transfer rate found on the original Thunderbolt. USB 3.1 also introduces a more compact, reversible Type-C connector that supports other protocols (more on this in a bit). The developers of Thunderbolt, Intel, recently announced Thunderbolt 3. The third revision boasts a 40Gbps max bandwidth, which is double that of Thunderbolt 2. Thunderbolt 3 also supports up to two 4K displays (via DisplayPort 1.2) and up to 15 watts of power for bus-powered devices.

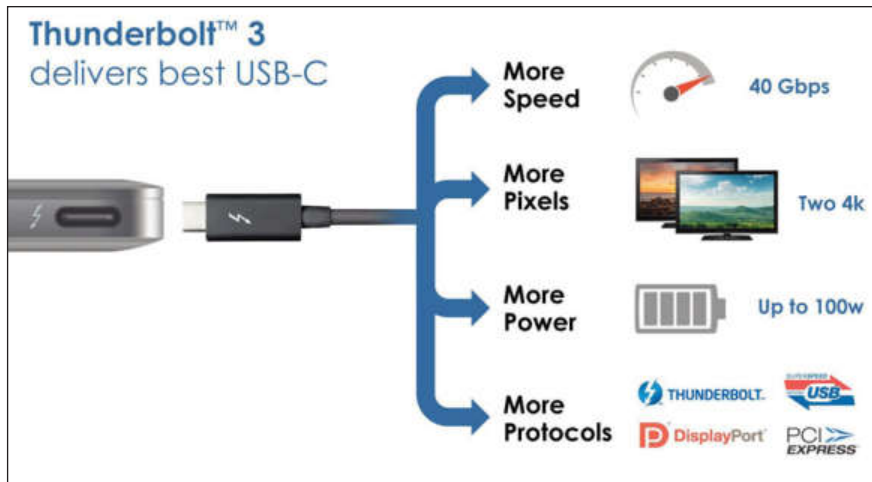
As is sometimes the case with rivalries, competition can bring you closer together. One of the most compelling features of Thunderbolt 3 is that Intel has replaced the Apple-developed mini DisplayPort connector with USB's Type-C connector. The change to the Type-C port allows USB 3.1 devices with a Type-C port to function over a Thunderbolt 3 port (though it'll transfer at USB 3.1's 10Gbps maximum). And the combination of Thunderbolt 3 and USB 3.1 paves the way for whole new lineup of PC peripherals, including single-cable docking stations and external GPU capabilities for notebooks.

Thunderbolt's Background

Thunderbolt first struck in February 2011, but Intel introduced the interface's concept back in 2009 as Light Peak. Light Peak was designed to use fiber-optic cables that connected to a controller chip that would route I/O traffic and allow Light

Peak to be compatible with almost all I/O protocols. The concept was revolutionary, because you'd only need one connector for whatever devices you wanted to connect to your PC. For instance, the conceptual Light Peak standard was intended to support USB, FireWire, RJ45 networking, and digital displays. Light Peak devices could also be set up in a daisy chain.

The first Thunderbolt iteration did much of what Intel sought when conceptualizing Light Peak. It supported both data transfer (via the PCIe interface) and video (via DisplayPort), and Thunderbolt's 10Gbps of bi-directional bandwidth allowed for a daisy chain of up to six devices. All of the devices within the chain needed to be Thunderbolt devices, but at the end of the daisy chain, you could connect an HD monitor via Thunderbolt's DisplayPort connection. Thunderbolt's fast data transfer rate and support for HD displays—over a single cable—made it a hit with content creators.



Thunderbolt 3 natively supports PCIe, DisplayPort, USB, and Thunderbolt protocols, as well as power for system charging or bus-powered devices.

the bandwidth to 20Gbps and add support for 4K displays. It's even possible to both display and transfer 4K content at the same time. Thunderbolt 2 maintains backward compatibility with Thunderbolt devices, and you can still daisy-chain up to six Thunderbolt devices and then add a DisplayPort monitor behind the last Thunderbolt device. The same cables people use for Thunderbolt also work with Thunderbolt 2 devices.

The compatibility between Thunderbolt and Thunderbolt 2 is possible because the basic architecture of the two standards is similar. Intel was able to increase the speed by reallocating the bandwidth of the full duplex 10Gbps channels into two bi-directional 20Gbps channels. An added bonus of aggregating the upstream and downstream channels is that Thunderbolt 2 gains the bandwidth necessary for 4K video. The 20Gbps bandwidth also helps to expedite file transfer time, as Thunderbolt 2 is twice

To support the original Thunderbolt on the PC end, your computer's motherboard required a Thunderbolt controller and, of course, Thunderbolt ports. In some instances, motherboard manufacturers would integrate both the Thunderbolt controller and ports into high-end boards. In other implementations, only the Thunderbolt controller would be onboard, so you'd need to buy an add-on card with Thunderbolt ports. At the time of Thunderbolt's release, most entry-level and mid-range motherboards lacked Thunderbolt controllers, as the controller was more costly than USB.

To be part of a daisy chain, each auxiliary device would need two Thunderbolt ports, one to connect to the upstream device and one to the downstream device. The initial Thunderbolt cables could be either electrical or optical, and this is still the case today. Electrical cables have a shorter length (up to 3 meters) than the optical cables (up to 50 meters), but electrical cables can provide up to 10 watts of power for bus-powered devices and have become the most commonly available option.

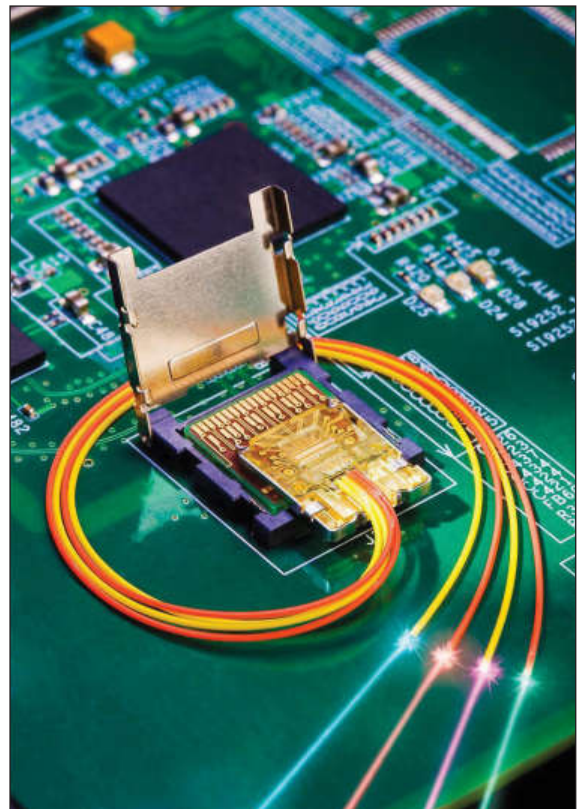
From a signaling standpoint, the original Thunderbolt protocol ensured a full 10Gbps of bandwidth to all connected devices by providing two full-duplex channels, each with a bi-

directional 10Gbps support. Flexible QoS (Quality of Service) allows for the multiplexing of burst data transmissions while maintaining full speed for DisplayPort communications. All data, whether PCIe or DisplayPort, is sent via a packet-based protocol. The host PC will recognize if the connected device requires PCIe or DisplayPort packets. The Thunderbolt standard also features a low overhead, so any connected devices will receive as much of the 10Gbps bandwidth as possible.

Thunderbolt found quick adoption among audio and video professionals, as it provided a way to capture and edit multiple uncompressed video streams in real time and even back up video files at the same time. Thunderbolt was less successful in the mainstream market, as there were relatively few Thunderbolt devices and even fewer Thunderbolt displays.

Thunderbolt 2

With Thunderbolt 2, Intel was able to increase



Thunderbolt was developed based on Intel's Light Peak designs.

as fast as the original Thunderbolt, four times faster than USB 3.0, and 40 times faster than USB 2.0.

Thunderbolt 3

Thunderbolt has always held the speed title over USB, yet even though it left comparable USB standards in the dust, Thunderbolt wasn't adopted by the mainstream. With Thunderbolt 3, Intel hopes to eliminate some of the issues that have held back the standard. It all starts with the USB Type-C connector, which helps to unify the numerous options for display, storage, power, networking, and docking into a single standard connector. The USB Type-C port also supports up to 100 watts of power for system charging and 15 watts to bus-powered devices, so it can provide power where necessary.

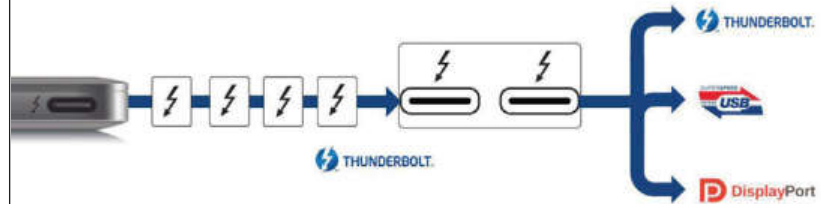
"If you've been following Thunderbolt over the years, you know that up until now it's been mainly Mac and a little high-end PC," says Jason Ziller, director of Thunderbolt marketing at Intel. "With USB Type-C, we're seeing stronger adoption

A Brief History Of USB & Thunderbolt Speeds

Bandwidth for the USB and Thunderbolt standards have steadily increased over the years. Here's a brief recap that shows how far the standards have come.

Standard	Speed
USB 1.0	12Mbps
USB 2.0	480Mbps
USB 3.0	5Gbps
USB 3.1	10Gbps
Thunderbolt	10Gbps
Thunderbolt 2	20Gbps
Thunderbolt 3	40Gbps

Device Configurations



Second device port operates the same as computer port and supports Thunderbolt, USB, and DisplayPort devices

Daisy-chain up to six devices with Thunderbolt

Similar to previous Thunderbolt versions, you can daisy-chain up to six devices and attach a non-Thunderbolt device to the end of the chain.

More Pixels



Large displays with amazing detail

- Twice the video bandwidth of any other cable
- **Single-cable** connection for **two 4K 60Hz** or a **5K 60Hz** display
- 2 streams (eight lanes) of DisplayPort 1.2

Thunderbolt 3 can support two 4K, 60Hz displays.

already in the PC industry." Ziller points out that several PC OEMs have recently announced notebooks and systems with Thunderbolt 3. Joseph Shih, MSI's notebook product manager, also believes that the use of the Type C connector will help with adoption. "Since Thunderbolt 3 and USB 3.1 both take Type-C as a standard connector, the synchronization surely helps its acceptance in the market."

Bandwidth is another area where Intel has made big strides with Thunderbolt. "Thunderbolt 3 doubles the bandwidth of Thunderbolt 2, so the overall bandwidth

goes from 20Gbps to 40Gbps," says Ziller. "And then, if you look at data and video performance, you're doubling both of those pipes." Thunderbolt 3 takes advantage of four PCIe 3.0 lanes, whereas Thunderbolt 2 could use only four PCIe 2.0 lanes. "And on the video side, Thunderbolt 3 supports two DisplayPort streams that can each handle a 4K display," says Ziller. The display pipeline allows a single Thunderbolt 3 port to drive two DisplayPort monitors with the help of a dual video adapter or a dock with two DisplayPort outputs.



MSI's upcoming lineup of GT72 gaming laptops are expected to feature a Thunderbolt-ready Super Port.

To connect with current-generation DisplayPort monitors, you'll need an adapter to use the Type-C Thunderbolt 3

port. "Future DisplayPort monitors with a Type-C input will only require a Type-C to Type-C cable," says Ziller. Type-C

adapter cables are also available to let you connect HDMI, DVI, and VGA displays to a Thunderbolt 3 port. There's some headroom for future display standards, too, as Thunderbolt 3 can handle one 4K display at 120Hz or a single 5K display (5,120 x 2,880 resolution) at 60Hz.

One of the more common complaints with previous Thunderbolt versions was the cable expense, as one cable often cost upwards of \$40. "With Thunderbolt and Thunderbolt 2, people use what we call active cables that have components that boost the signal, so you can run high-speed over the cable," says Ziller. The specialized components in the active cable raises cost. Ziller says Intel is introducing two types of cable choices with Thunderbolt 3. "The first one is basically the standard USB Type-C cable, which we call a passive cable because it doesn't have any active signal booster inside."

Passive cables, of course, will cost less, but will only support Thunderbolt 3 at up to 20Gbps (and will still transmit both data and video). Active cables with transceivers will also be available to support the full 40Gbps speed. Ziller says "The active Thunderbolt 3, Type-C cable will cost around the same as existing Thunderbolt cables."

Thunderbolt 3's versatility with I/O protocols also makes it a good solution for device docks, as a single Thunderbolt 3 port can drive two 4K displays, USB ports, and an Ethernet connection, and still charge your system (up to 100 watts). "A multi-purpose dock that uses single cable to communicate with several legacy devices is one of the most compelling new scenarios," says Shih. When paired with a Thunderbolt 3-enabled notebook, for example, you can just plug and unplug the Thunderbolt 3 cable running from the dock, when necessary.

Thunderbolt 3 can also be made compatible with legacy Thunderbolt devices

External Graphics & Thunderbolt 3

External graphics capabilities have often been mentioned as a possibility with previous Thunderbolt versions, and there's hope that it will finally become a reality with Thunderbolt 3, thanks to the extra PCIe bandwidth. Notebooks with marginal gaming capabilities could be instantly upgraded with an external GPU over Thunderbolt 3. Jason Ziller, director of Thunderbolt marketing for Intel, had this to say about external graphics over Thunderbolt, then and now:

"External graphics over Thunderbolt is a very interesting usage, and Intel has seen a lot of demand for it. Intel runs a Thunderbolt certification program for devices to make sure everything works correctly. And in the past, we found that if you unplugged the cable with external graphics it would blue-screen the OS. We didn't certify any of those devices. As we go forward with Thunderbolt 3, there's a couple of things that are better. First off, you'll get improved performance by doubling the PCIe bandwidth from Thunderbolt 2. Secondly, Windows 10 makes it easier for graphics vendors to support hot-plugging (though it's still not native in Windows), so we are working with graphics vendors—initially AMD—to do a driver that supports hot-plug and surprise removal. Going forward, we expect to see some external graphics devices come to market, although I can't say exactly when, but at least initially, these solutions will be dedicated PC and device solutions, because the driver and BIOS needs to be customized and validated for the solution. As such, it's not going to be something that you can buy online and plug into any old Thunderbolt 3 port."



via a USB Type-C-to-mini DisplayPort adapter, so consumers with existing Thunderbolt devices won't be left out in the cold. Those same adapters should also provide support for people who want to use Thunderbolt 3 devices on an existing Thunderbolt port.

Another powerful addition to the Thunderbolt 3 package is support for 10GbE networking, which would allow computers connected via Thunderbolt to transfer data at the speed of high-end servers and workstations. "When we talk to the people at IBC or NAB who are video creators, they are very much into having small workgroups that share storage, so they can work together on video projects," says Ziller. "For mainstream usage, setting up two computers in a peer-to-peer fashion will be incredibly convenient." The 10GbE network connection will make for especially fast transfers. Intel indicates that a 4K movie will transfer in less than 30 seconds.

Notable Devices With Thunderbolt 3

Thunderbolt 3 has a lot of promise with notebooks, and like Ziller mentioned, several recent notebook announcements have highlighted Thunderbolt 3 connectivity.

Unrivalled single-cable docking

← Up to 100W charging
Display - 8 lanes →
Data →

Effortlessly connect to everything you need

- Only way to get 4K 60Hz video + data from one USB-C
- Connect two 4K 60Hz displays with a single cable from computer
- Quick notebook charging

Single-cable docking is an option that OEMs might use to replace conventional mechanical docks for notebooks.

Overseas, for example, MSI has released the GT72 6QE DOMINATOR PRO G featuring a Super Port that's Thunderbolt 3 ready and provides transfer speeds up to 1,000MBps, as well as support for up to two 4K displays. MSI tells us that you can expect GT72 Dominator notebooks with the Super Port (no specific SKUs yet) in the near future.

GIGABYTE recently released the first motherboard to meet Intel's Thunderbolt 3 certification standards.

The GA-Z170X-UD5 TH comes with two USB Type-C ports driven by Intel's Thunderbolt 3 controller. The dual Thunderbolt 3 ports allow you to daisy-chain up to 12 devices in addition to the two 4K displays, so you can be sure that you won't be lacking for Thunderbolt 3 connectivity. The GA-Z170X-UD5 TH also supports the latest NVMe storage devices, as GIGABYTE includes a M.2 to U.2 adapter that lets you switch the boards' M.2 port into a U.2 port that supports a bandwidth of up to 32Gbps. Whether you're transferring data internally or externally, the GA-Z170X-UD5 TH has you covered.

Keep An Eye To Sky

Thunderbolt and Thunderbolt 2, while being perfectly speedy interface options, never quite took off in non-professional circles. The Type-C connector and native support for USB 3.1 should make Thunderbolt a much more appealing interface for device manufacturers. And based on the initial implementations from PC OEMs, it appears that Thunderbolt 3 is more likely to be found in prebuilt systems. Like any brand-new standard, we can't be sure that Thunderbolt 3 will reach its full potential, but based on the changes Intel has made to the interface, we like its chances. ■



The GA-Z170X-UD5 TH is the world's first Intel Thunderbolt 3 Certified motherboard, and it offers two Thunderbolt 3 ports.



msi



CHOOSE YOUR DESTINY

MSI Z170 GAMING MOTHERBOARDS

9.9



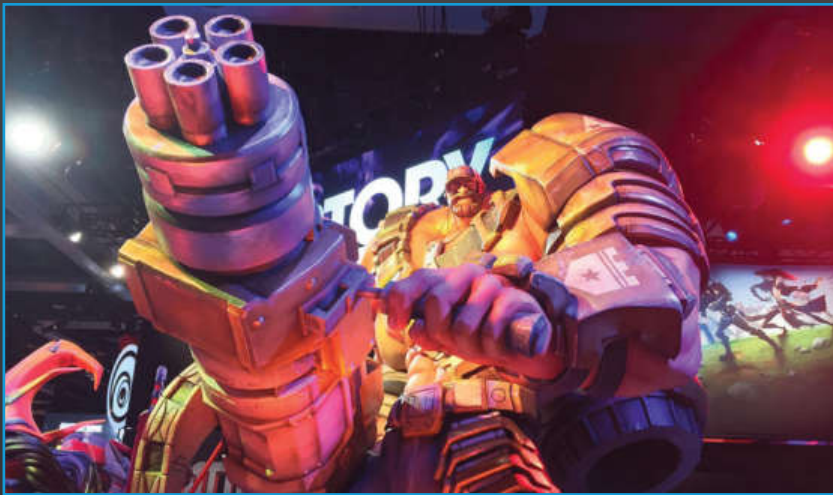
MSI Z170A GAMING M7

"From the box design and down to getting it all up and running, I had a smile on my face all the way. This most definitely is not the MSI of old. Today's MSI is almost perfect." -Techpowerup

PAX Prime 2015

Wild Times In The Emerald City

Try to wrap your head around the fact that one of the biggest videogame expos in the world, one that has spawned two additional shows in the United States and one in Australia, initially hosted fewer than 4,000 attendees. You can't. The Penny Arcade Expo, now known as "PAX Prime," stuffs tens of thousands of enthusiastic gamers of all kinds into the Washington State Convention Center for four full days of gaming madness. Tickets to the event sell out within minutes, and the show now sprawls across several buildings in downtown Seattle. As usual, *CPU* was there to take part in the madness.



If you've been to PAX (any PAX) before, then you know that exhibitors on the main floor have a penchant for spectacle. Booths, if you could call them that, are enormous, and the wonders you'll find within are even more enormous, like this larger than life replica of Montana, one of the characters already announced for 2K Games' upcoming shooter Battleborn.

Major publishers put their best feet forward at this year's PAX Prime. From Halo 5 to Super Mario Maker, attendees had a chance to get their hands on the hottest games of this fall and 2016.



Like previous years, Team *CPU* was stationed on the considerably less riotous sixth floor of the Washington State Convention Center, but we still know how to throw a pretty good party. Of course, giving away a fully loaded gaming PC as a party favor tends to draw a large crowd wherever we go. In the waning hours of PAX Prime 2015, hundreds of hopeful attendees gathered for their shot to take home our final *CPU* System Workshop build of the year, Sasquatch.

Powerful PC Hardware & More

PAX Prime is generally regarded as a gaming expo, that's true, but considering that a large percentage of gamers associate themselves with the PC Master Race, it's no surprise that plenty of top-tier component manufacturers were on hand to show off their wares and give eager attendees hands-on access. In a few instances, these companies had a few surprises in store, such as live modding demonstrations and professional eSports tournaments.

Throughout a good portion of PAX Prime, MSI pitted the top eSports competitors in Heroes of the Storm and StarCraft II against each other for the MSI Gaming Arena Grand Finals. Spectators packed the area as these pro gamers battled each other for glory and cold, hard cash. In the end, MVP Black swept Tempo Storm 3-0 to take home the gold in HoS, while StarCraft II pro sOs added to his already sizable career earnings by shutting out Solar, 3-0.

MSI also let regular gamers rub elbows with a pair League of Legends pros, Faker and MaRin, as well as play with some of the company's latest gear.



Credit: Helena Kristiansson



Modding and making were front and center at Cooler Master's booth, which included one of the largest 3D printers we've ever seen.



GIGABYTE brought its hottest hardware to PAX Prime, and attendees could prove their allegiance by receiving a tattoo, which may or may not be permanent.

Virtual reality was an actual reality everywhere at PAX Prime. Although Oculus VR had the largest VR presence at the event (duh), several other exhibitors were on hand to showcase their VR offerings. Hardware manufacturers such as ASUS were on hand to give attendees a taste of VR (and let their friends chronicle their wild flailing on Instagram), and plenty of game developers had their VR worlds ready to explore.



All Things Gaming

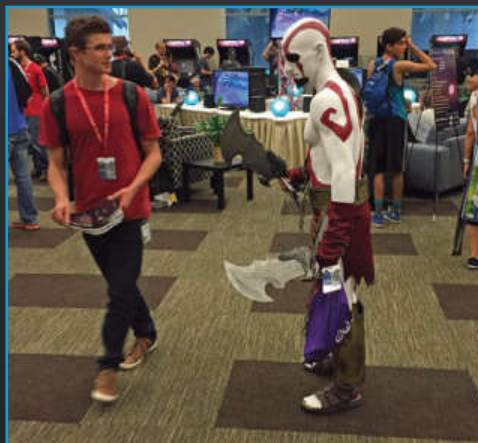
Perhaps the coolest aspect of PAX Prime is that it offers something for almost any kind of nerd, whether their passion is videogames (AAA or indie), tabletop games, cosplay, comics, PC hardware, or several of the above. Geek culture itself reigns supreme here, and there was no shortage of things to do. With costumes on and CCG decks in hand, PAX Prime attendees devoured everything the show had to offer, from tournaments to panels to concerts.

What, your city *doesn't* have a giant magical beast bursting forth from a building to terrorize local law enforcement? Across the street from the main exhibition hall, Magic: The Gathering made its presence known to passersby, whether they were attendees or not. In addition to promoting its upcoming Battle of Zendikar release, MTG held its 2015 World Championship at PAX Prime, crowning Seth Manfield the victor.



A life-sized clockwork soldier from Bethesda Softworks' Dishonored 2 was on hand to give attendees a full tank of nightmare fuel. In addition to Dishonored 2, Bethesda also promoted its two other tentpole franchises with upcoming releases, DOOM and Fallout.

The god of war is apparently not the god of navigation, as Kratos demands directions from a fellow PAX Prime attendee. Cosplay is a major fixture of the event, with hundreds of attendees dressing up as characters from videogames, comics, movies, and more.

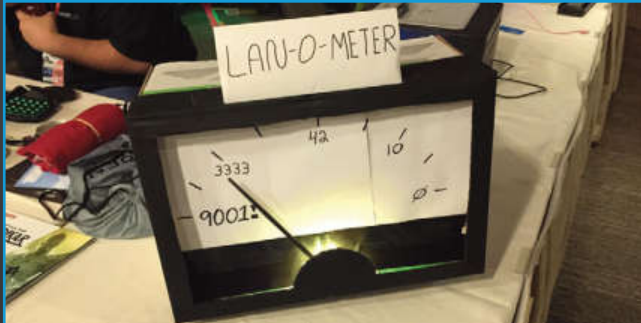


Einstein got it wrong: God does play dice with universe, provided the die is of the 20-sided variety.

Intel LANFest & PC Freeplay

Possibly the best kept secret (if there truly are any) at PAX Prime, Intel's LANFest and PC Freeplay area is a party within a party. These two events took over the third floor of the Annex building and offered over 600 seats combined. (LANFest attendees had to register separately for the LAN party, too, of course.) Every night as the action wrapped up at the expo, it was only heating up at the LAN party and PC Freeplay area.

If the name Gayle Taves sounds like déjà vu, it's because you've seen it before. As it turns out, Taves won the Intel LAN Fest mod contest at PAX Prime 2014 with her Plants vs. Zombies Pea Gatling mod. (Turn to page 63 of the October 2014 issue to scope it out.) If there's one thing Taves like better than building turret gun mods, it's winning mod contests. Taves used lots of MDF, a few bolts (including one 10-inch bolt that supports the entire frame), PVC pipe, and a plastic mop bucket to create her Team Fortress 2 sentry gun scratch build. After 200 hours of painstaking work ("the sanding was the worst," says Taves) her mod was complete. It will now attempt to mow down the competition as part of the contest for best Intel LANFest mod of 2015.



At the admin desk, a carefully calibrated and very official-looking LAN-O-METER provided a precise, quantitative assessment of the LAN. And yes, it surpassed 9,000 on more than one occasion.



Intel's PC Freeplay area was hopping for most of PAX Prime, with lines forming as attendees hoped to blow off a little steam, and blow up a few enemies, on one of the 300+ custom gaming PCs Intel assembled for the event. Gamers were able to play several LAN favorites, including Dota 2, Rocket League, and CS:GO, or kick back with other popular titles such as Don't Starve, Kerbal Space Program, and Starbound.

CPU At PAX

When we weren't busy judging the LANFest mod contest or chronicling the many, many sights of PAX Prime, *CPU* was busy manning our satellite base on the sixth floor of the expo hall. We always have a great time talking shop with fellow power users, as well as encouraging newbies to become the next generation of power users, and this year's PAX Prime was no different. Mods, modders, and modding were all present and accounted for at our booth, too.

Tens of thousands of people came to PAX Prime, but only one left with a tricked-out gaming PC courtesy of *CPU*. This year's lucky winner was Angela E., who adopted Sasquatch as her own. This monstrous PC replaces her 2010 Mac laptop, which, according to Angela, "Was not doing it for me." Angela, who is an illustrator, plans to use Sasquatch to run Photoshop, and when it's quittin' time, she's going to play her favorite games, *World of Warcraft* and *The Sims*. With an Intel Core i7-5930K and an MSI GTX 980TI GAMING 6G, Angela's new PC should be more than up to the task.



Richard "Darth Beavis" Surroz slipped away from Cooler Master's booth to provide a live PETG pipe bending demonstration to a group of future modders at our booth.



Helen T. proudly shows off the brand-new In Win 805 case she won at our giveaway.

PDXLAN 26

Frag & Friends

To call PDXLAN “huge” does it a bit of a disservice. What started years as a small gathering of close friends has grown to become a very large gathering of close friends. In fact, it’s not even one gathering anymore. PDXLAN itself convenes thrice yearly (February, July, and November), and over the last few years event founder Matt Conwell has grown the PDX franchise to include PDXAGE, a tabletop gaming extravaganza, and Vector LAN, a 21-and-over LAN party. Clearly, the man likes to party.

We like to party, too, so we packed our bags and headed west to attend PDXLAN 26, which kicked off Friday night, July 17, and grudgingly wound down Monday, July 20. Over three crazy days and nights, PDXLAN attendees battled each other in tournament play, in the dodgeball arena, and in several other feats of nerd strength.



It’s one thing to create T-shirts of your LAN party to distribute to your devoted attendees. It’s another thing altogether when those attendees are so devoted to your LAN party that they make their own. Of course, this is the kind of camaraderie and fanaticism that PDXLAN inspires. It’s no wonder tickets to the LAN party sell out within an hour or two of going on sale. PDXLAN 26 was no different.



Founder and admin extraordinaire Matt Conwell addresses the PDXLAN faithful.

Party At Conwell's House

The second you walk through the doors of the Columbia Conference Center in Portland, Ore., you get a sense of the welcoming environment that PDXLAN cultivates. Oh, the competition is as fierce as any LAN party, but it's clear that people come to PDXLAN to have fun and make friends.



Taking a break from the action online, PDXLAN attendees stepped away from their PCs and into the dodgeball arena (and 90-degree heat, no less) in order to fight to death (*Ed. note: unverified*) for phat lewt, courtesy of Crucial Memory.



Although only a small percentage of PDXLAN attendees are modders in the strictest sense, many of them are accomplished builders. PDXLAN is littered with sweet, custom PCs that would make any enthusiast jealous.



As you can see, in order to prevent hundreds of thirsty gamers from devouring the event's supply of energy drinks within minutes, drastic measures had to be taken.

Multiplayer tournaments, whether part of the official schedule or unofficially organized by attendees itching for a fight, are a fixture of PDXLAN. Blizzard's new MOBA Heroes of the Storm was one of the titles that dominated widescreen monitors at the event.



U Mod, Bro?

The Pacific Northwest boasts some of the finest modders in the country, and we've seen some truly amazing mods at PDXLAN over the years. At PDXLAN 26, several hall-of-fame modders—if there was such a thing as the PC Modding Hall of Fame—entered the *CPU* mod contest to compete for a spot in “Mad Reader Mod.” We knew we'd find more than a few spectacular mods as we walked the aisles, and the modders in attendance did not disappoint. We've saved the winner of the PDXLAN 26 mod contest for this month's “Mad Reader Mod,” but for now feast your eyes on these four very worthy runners-up.



3D printers are pretty popular these days; perhaps you've heard of them. Chris Ost certainly has, as his fifth-place NODE scratch build owes much of its composition to the technology. Ost elected to use a third-party service for his 3D printing work, as the tolerances required for his build were too low for his MakerBot 3D printer, but the CAD work is 100% Ost.



One of the NODE's most compelling traits is its expandability. Ost designed the case to be modular, letting him add extension pieces and replace NODE's acrylic panels with much larger panels, if desired.



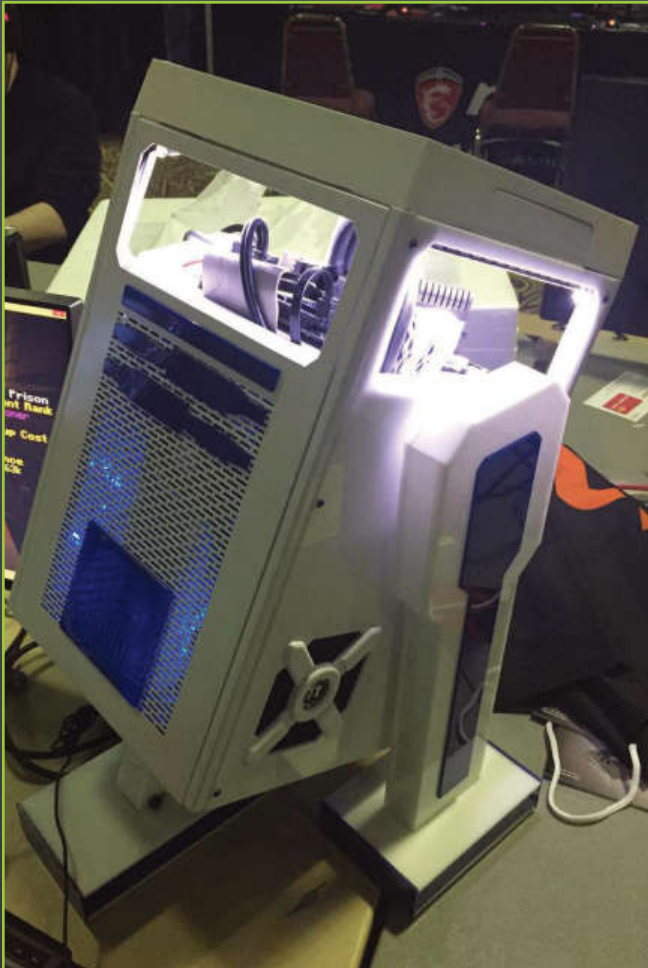
The fourth-place mod is a scratch build from Josh Sniffen, a modder known for his scratch builds. Sniffen's S4 is small but mighty. He created the S4 with two roles in mind: It can lay flat and function as an HTPC at home, and it's thin enough to fit in a laptop bag when Sniffen has to hit the road.



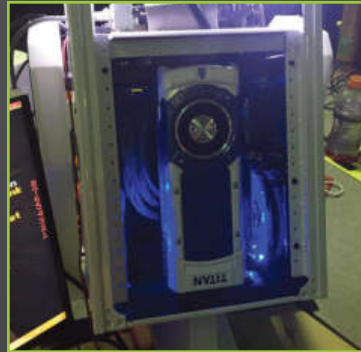
A master metalworker, Sniffen used two types of aluminum to build the S4. The wraparound front panel is 5052 brushed aluminum, while the sides are 6061 aluminum that Sniffen painted with an iridescent powder coat that changes color when exposed to sunlight.

HARD HAT AREA

PC MODDER



Capitalizing on our renewed obsession with the “Star Wars” universe, Brian Carter delivered his R2-M1 mod, which claimed the bronze medal in our contest.



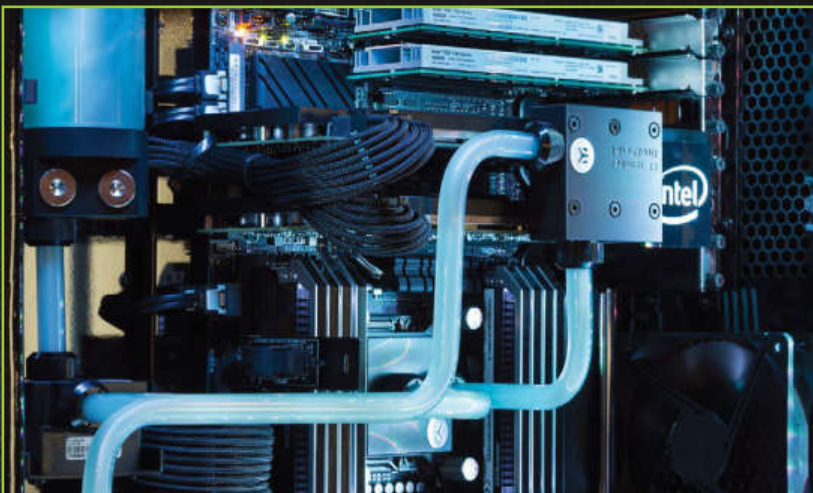
Carter also built R2-M1 to be a mod of a mod: It’s styled to look like an astromech droid as it appears in a Minecraft mod. Naturally, the system is also great for playing Minecraft, thanks to an NVIDIA GeForce TITAN Black, which Carter modded to match.



Another PDXLAN, another exceptional Surroz mod (above, left), but the primary modder behind this system isn’t the Surroz you think. The mod named “To Boldly Go” is the handiwork of Richie Surroz, son of Richard “Darth Beavis” Surroz. To achieve this one-of-a-kind look, Surroz the Younger, with help from Surroz the Elder, took an In Win S-Frame case and fused it with a Case Labs Pedestal case, the latter of which holds the mod’s waterworks. A Starfleet insignia is laser-cut into the side panel, giving the mod its name.



HARD HAT AREA
PC MODDER
MAD READER MOD



Magneto Black

There's nothing like a little healthy competition to force the best of the best to be even better. We see it all the time in the professional sports world, where athletes transcend their normal levels of greatness to deliver truly historic performances when it matters most.

PDXLAN has a similar effect on modders. The Pacific Northwest is teeming with talent, modders who have spent years honing their craft. So when the Portland, Ore. LAN party opens its doors for its February and July events, there's no shortage of incredible creations for attendees (and mod contest judges) to ogle. PDXLAN 26 reaffirmed this once more, as any of the runners-up could've won a mod contest at another venue.

But they did not win. Trust us, though, finishing behind the PDXLAN 26 CPU mod contest winner is nothing to be ashamed of. Our best in show is a truly impeccable work of art. Then again, that might not surprise you if you're familiar with the professional modding scene. The dynamic duo that produced this cool, clean mod are Mad Reader Mod alumni. The BS Mods tag team of Bob Stewart and Rod Rosenberg suplexed the competition and claimed first place yet again with this stunner of a mod.

1 + 1 = Over 9,000

Although Stewart and Rosenberg have each appeared in "Mad Reader Mod" individually, most of their recent projects have been collaborative efforts. (Look no further than our September 2013 issue for Stewart and Rosenberg's Throne Industrial mod, which coincidentally claimed victory at PDXLAN 22.) The two have

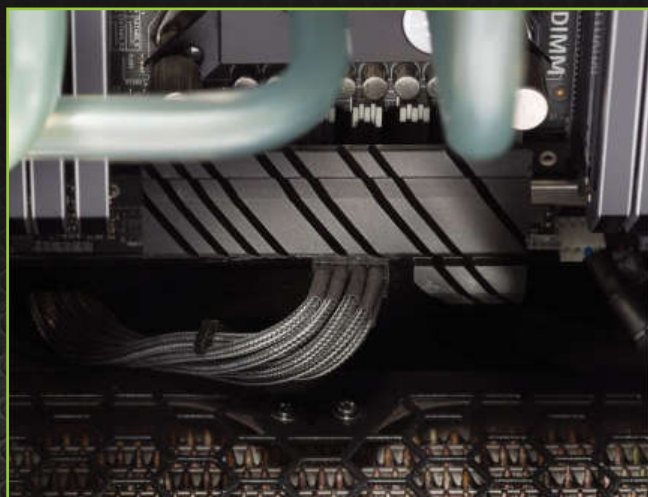
made mods that run the gamut from bombed-out to space-age. For Magneto Black, they agreed to class up the joint.

"We built this for Intel to show off," Stewart says. "We had to keep it as clean as possible and very professional-looking. We wanted it to be a mod that has a Rolls Royce flair."

As if they share a creative brain (we're investigating), Rosenberg adds, "This system is just simply elegant. I can't think of anything better to compare it to than a Rolls Royce Phantom in black."

With their vision for Magneto Black established, Stewart and Rosenberg headed to the former's shop and got to work. And work they did, to the tune of 200 hours, according to Rosenberg's estimate. They spent some of that time mixing a custom acrylic urethane paint that gives the mod its name. After stripping a Case Labs Merlin S8 down to its bones, Stewart and Rosenberg shot it with their custom mix, but they didn't stop there. To achieve Magneto Black's mirror finish, they also applied clear coat after clear coat—by Stewart's estimate, "about 10 coats." Stewart and Rosenberg then commenced a rigorous routine of sanding and buffing until Magneto Black's finish was appropriately reflective. The Intel logo on the left side panel is a metallic silver.

Rosenberg's and Stewart's custom work is evident throughout Magneto Black. The hardline tubing is immediately obvious when you look through the mod's clear side panel window, and the use of Mayhems Aurora 2 coolant makes the loop pop in a way that standard coolants can't match. The system's SLI bridge is a piece of black acrylic, and the BS Mods team added Intel's logo to that, as



HARD HAT AREA PC MODDER MAD READER MOD

well. More black acrylic hides Magneto Black's EK Water Blocks CoolStream 360mm radiator edge and the fans beneath it.

SSDs Everywhere

Aside from its killer processors, Intel is well-known among enthusiasts for its ultra-fast, ultra-reliable solid state drives, a fact that Stewart and Rosenberg wanted to represent in a big way. For that reason, Magneto Black is armed with a whopping seven SSDs; its roster includes two 400GB Intel SSD 750 PCIe SSDs, a 2.5-inch 1.2TB SSD 750, and a quartet of 240GB SSD 730s, the latter of which are presented in cascading fashion in their own custom chamber at the front of Magneto Black.

"We needed to showcase the storage on this build so we created the waterfall style front display area," Stewart says. "It has the SSDs at an angle, and they are all lit from the top to really make them stand out. The back side is also made with black shiny acrylic so it keeps it all clean when you look in the side window."

Rosenberg explains how he and Stewart inverted Magneto Black's motherboard tray in order to showcase the PCIe 750s. "We moved the case to a reverse ATX style with the PCIe slots at the top of the case allow the PCIe SSDs to sit nicely above the dual GTX 980s."

Awesome Elsewhere

Magneto Black has a storage subsystem that puts most other rigs to shame, but the rest of its hardware is mighty impressive, too. Rosenberg and Stewart loaded their mod with an Intel Core i7-5960X Extreme Edition CPU, ASUS X99-DELUXE, 32GB of Corsair Dominator Platinum DDR4-2666, a pair of NVIDIA GeForce GTX 980 Ti graphics cards, a Corsair AX1200i PSU, plus the aforementioned SSDs.

EKWB waterblocks cover the CPU and graphics cards, and an EKWB pump keeps the coolant circulating. Stewart and Rosenberg connected their cooling components with PETG tubing and set the whole thing off with PrimoChill fittings.

You Can Sleep When You're Dead

Like true competitors, Rosenberg and Stewart didn't stop long to savor their victory. Stewart says, "We have already completed several mods since this one and have more on the schedule. It never ends."

Keep making mods like this, guys, and it never will. (And that's just fine with us.) ■

We Want Your Mod

Have a computer mod that will bring tears to our eyes? Email photos and a description to madreadermad@cpumag.com. If we choose your system as our "Mad Reader Mod," we'll send you a cash prize and a one-year subscription to *CPU*. (U.S. residents only, please.)



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CONTOUR

MOBILE GAMING CONTROLLER



Tt esports
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Made for
iPod iPhone iPad

Bluetooth

TechDaddy Triumphant

Modders-Inc.com's Staff vs. Staff Mod Contest For 2015 Is In The Books

Back in the August issue, the guys from Modders-Inc.com discussed their various strategies for winning this year's Staff vs. Staff Mod-Off, and we showed you some past samples of their work, including last year's superhero-themed mods. This year, the field included six modders, which is the most entries in a Staff vs. Staff event so far, and focused on either a Quake or DOOM theme. Judging took place at QuakeCon and was handled by a panel that included master modders Bob Stewart and Rod Rosenberg, as well as Thermaltake's Shannon Robb. (Thermaltake sponsored this shindig and supplied each of the contestants with a Core X1 case to get them started.) This time around, we will hear from all six of the guys, starting with the three who didn't make the top three, and then working our way from third place to the winner.

Alex Lusakhpuryan: Insomniac

I named my mod "Insomniac," and there are two reasons for this. The first is that I did most of the work on this project at night, and the second is the nightmare that the mod is supposed to remind people of. My initial idea was to try and use 3D printers to achieve a "skin face" texture on the case, but when I did the math, I realized that this would put me over our \$250 budget. So, instead I decided to refinish the case to give it a reflective surface and then attach skulls to the outside so that they have a 3D effect and look like they are emerging from the system.

Stripping and polishing the case took a long time, and several times during the



Alex Lusakhpuryan's Insomniac mod didn't win this year, but if there were a secondary award for Best Use Of Skulls, it would get our vote.

process I second-guessed my decision to go that way, but in the end it was all worth it. It also took a while to find the small skull props and steer skull I needed to complete the look, but eventually I found a seller on eBay who sold me the small skulls at a very reasonable price. I was looking to use a real steer skull on the build, but that would also have been outside my budget, so I found a steer skull prop at a consignment store and decided to go that way. I put magnets on the back of the small skulls to attach them to the case, so you can move them around as you please, and I added some orange LED strips to the interior of the build that really add the Quake/DOOM effect to the whole mod.

Overall, this mod was fun to work on, and I feel that the biggest challenge was sticking to the budget. By putting restrictions on our work, we really challenge our creativity and imagination, and it helps us show people what you can accomplish without spending a lot of money.

Joe Mercado: Facility 23

My vision for this mod was to recreate the feel of a DOOM 3 UAC facility. I knew that it would be a bit difficult and heavy to do this with metal, so after getting some inspiration from Ron Lee Christianson on his Half-Life and Aliens projects, I decided I was going to use high-impact polystyrene (or "HIPS" for short). With this material, I would be able to make special panels and build up the effects without adding the weight that metal would bring to the chassis.

The first thing I made was a custom motherboard tray for the Thermaltake X1, converting it from Mini-ITX to mATX. This was both an aesthetic mod as well as a functional change. Up next was building up the outer panels to match some of the scenes and surfaces found in the game. The right side is modeled after the doors that can be seen throughout the game and the left side was a mashup of various views of the large windows that always seem to be present right before a big event in the game. I designed the top to wrap up the look of the heavily fortified facility but had overhead grating to add to the industrial look.

I knew from playing the game that the UAC facility didn't exactly have white lighting; it had a diffuse blue glow that



Joe Mercado went for the industrial look for his Facility 23 mod.

made it look cold and dead, and I was able to achieve something similar using a white cold cathode and the blue LEDs on my AVEXIR memory. I put a second cathode at the bottom to illuminate the area and show off a bit of the custom sleeving that I did for the project. I will sign off now with a big thank-you to Thermaltake for providing our canvases, and to all the sponsors involved that helped Modders-Inc make QuakeCon 2015 the best one yet!

Ron Perillo: Shub-Niggurath

Well . . . this turned out to be a disaster. It was a fun disaster, but I'm totally not happy with what I had. It basically came down to having three days to work on the mod prior to flying out, as July is a very busy month in terms of my personal life, my day job, and my responsibilities at Modders-Inc. I'm glad all the guys are very supportive, however, as this is my first mod and even the modders who were not with Modders-Inc shared some very encouraging words to keep me going.

As for the mod itself, the initial plan was basically to incorporate a monitor and I actually have worked out all the budget and everything but time just was not on my side. Even the sculpture, which was originally going to be Quake's main character in the center of the mod, had to

be replaced by Shub-Niggurath because she was much easier to sculpt. It just took 10 minutes using Super Sculpey acrylic clay. Prepping the wire skeleton (made from a coat hanger) and curing time in the oven actually took 10 times longer. Since the Thermaltake Core X1 came with magnetic filters, I made use of the magnetic strips to mount the front acrylic cover, the bottom mesh, and the LED strip lining the bottom. It was actually the perfect size and I did not even have to cut them width-wise. My total budget was only \$50, which mostly was from the clay and paint. Unfortunately, I hand-carried the giant box through the airport and the center sculpture did not survive unscathed—one

of the tentacles cracked at the top.

No big loss aside from my dignity in having to display that thing at the booth beside all the good ones from the other guys. But I'm not going to stop with this project just yet. Now that QuakeCon is over and I am not hindered by budget constraints, I intend to fully realize this project into what I originally envisioned it as (a fitting tribute to Quake) so that when QuakeCon rolls around next year, I will bring a finished version of this mod. And this time, it will be a mod I can be proud of.

Third Place

Nick Blackwell: Ultra-Violence

When I first started on this venture, my whole premise was to try and stick to mostly using things I had lying around the house, to show that you don't have to go through your whole bank account to have a custom PC. First up, every piece of metal in this computer has been corroded using a mixture of hydrogen peroxide, vinegar and salt. Then it was sealed using a

clear matte finish. Once that dried, I was able to go back over it with my airbrush and some UV green paint to make it seem as if there was still a corrosive substance on it. I cut every cable on the PSU to a custom length and individually sleeved it, and I made a custom PSU cover out of sheet metal. Inside, the case is designed to look as if the corrosive has spread into the cooling system, giving everything a slight greenish tint. To finish it off, I put an Imp action figure inside.

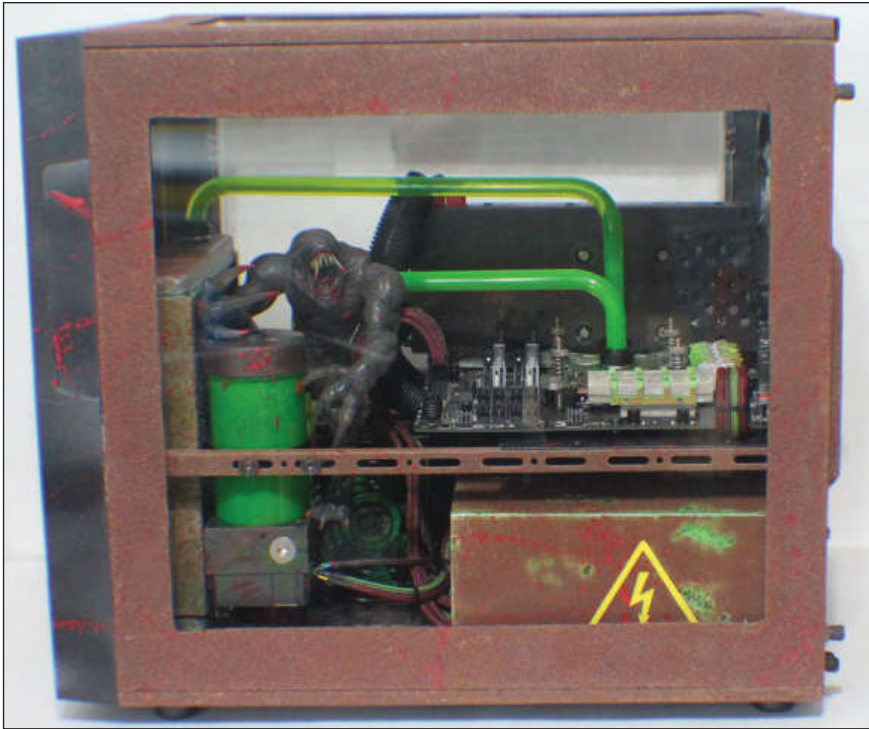
Second Place

Dewayne Carel: DOOM'ed

When you have a limited amount of time and money to create a case mod, sometimes you have to cross your fingers and hope for the best. "DOOM'ed" is the name of the case mod I created for the 2015 Modders-Inc Staff vs. Staff case modding contest, and I was hoping that it would not live up to its name. I guess I got lucky. Well . . . sort of. I was able to create the look and feel I wanted, which was a UAC rocket ammo crate with a different look on each side of



Ron Perillo sculpted a likeness of Shub-Niggurath inside his mod. She's the final boss of Quake, and soccer mom to hundreds of demons.



Nick Blackwell's Ultra-Violence looks like an industrial facility where an Imp is breaking stuff, allowing green corrosive goo to escape their conduits and corrode the facility.

the Thermaltake Core X1 case. As I stated in the previous article [Ed. Note: See page 48 in the August issue], I wanted to re-create the Icon of Sin on one side and install a monitor that showed DOOM gameplay footage on the other. I started off by creating the Icon of Doom with some smooth foam and crafted it to an OK look, in my opinion. Then, as I was checking some stuff on the web, I found a way to create some clay called "Cold Porcelain" that dries very hard. This was exactly what I needed, and it allowed me to create a much more detailed face. Issue number one found and then fixed.

Issue number two was the LCD screen for the other side. Not reworking the side panel or installing the screen, but the effect I wanted. My original idea was to make it so that that you could see the game being played and see the hardware inside through the screen, but that did not work out as well as I wanted. As you know, an LCD screen uses a flat rear panel as a light source to create the images you see; removing this panel was easy, and with an alternate light source and the screen laid out on my work bench, I was

able to see the movement of the game on the screen. "Sweet, I got this!" I thought, but I was not so lucky. You see, the Core X1 is a

very open-air case with perforated panels on all sides, and when you add a light source it can be seen from all angles very easily.

I had already used red and yellow LEDs to get the right mood lighting for the Icon of Sin on the other side, and when I added too many LEDs and a few white LEDs to create enough lighting for the LCD to look good, it totally made the rest of the case too bright. After trying several different locations and quantities of LEDs, I still could not get the right balance for everything to look good. So, I made an executive decision and put the light panel back onto the LCD. The rest of the case was easy to make as I used foam poster board to make the raised wood and then some creative painting to give it the right look. All in all, I am very happy with the way the case turned out and I was close on our budget limit of \$250 with a total of \$210 spent. I gladly accept my second-place finish, since we were all winners in this contest. And besides, if you always take first place where is the fun in that?

First Place

Craig "TechDaddy" Tate: D.E.A.D.

We debated whether to put hardware in our mods, and some of us opted to use



Doom'ed, by Dewayne Carel, incorporates the look of a UAC rocket crate with the Icon of Sin.

working hardware, while others left their machines empty to focus on the case mod. I opted to take a hybrid approach and install non-working hardware in my build! The mod's motherboard is an old laptop board that was dead. I took the blowtorch to it to create the damaged/burned appearance that it took the shrapnel that tore through the side window panel and left the burn holes. Then I attached an old, unused chipset heatsink from an EVGA Classified motherboard to make the system board look more exotic and powerful.

As you can see, the build was made to look like it had been through a massive, close-quarters battle, as described in the August issue. The supporting terrain effect was made by laying cotton balls on a wooden board and covering the mounds of cotton with a couple layers of fiber glass sheet. I created the veins by putting down cotton yarn and putting resin over them, so as to give the appearance of being under the "skin." Using the same effect on the side of the case, I wanted to roughen up the skin and make it look like it had pores and such, so I used the paint brush to dab the surface once it started to set up, to



Craig Tate's D.E.A.D. (Doomified Engineered Attenuation Device) neatly pulls off the look of a super-high-tech device that has been destroyed by some very bad business.

randomly pull up peaks and break up the smoothness of the surface.

I created the tear in the other side by cutting out a section of the top panel and

replacing it with a sheet of styrene. I then cut the tear out of the styrene and made downward cuts from the hole to allow for the styrene to curl outward as seen in the picture. Styrene is very flexible when heat is applied.

I cut the UAC logos out of vinyl and applied them to the Core X1's magnetically attached fan filters on the inside of the case. Next, I built the reactor rods out of two CCFL plasma rods, and inserting them into custom-cut PVC pipe that I painted carbon black. I took a silver paint pen to the edges of the busted pipe to give the pipe breaks a more metallic appearance.

The front armor plate is a piece of clear acrylic that I back sprayed with the carbon black, drilled holes along the edges to attach the threaded standoffs, and attached it to the front bezel of the X1. Then, to make the bullet impact dents, I spot-heated the acrylic with a blowtorch and pushed the depressions using a set of needle-nose pliers, and then let the acrylic cool to that shape. I then took the silver paint pen and applied it to the center of the depression, and the paint registered the silver center of the bullet strike. I also used the silver on the side of the acrylic to make the panel look more like a sheet of metal. ■



Did Tate destroy an EVGA Classified motherboard for this mod? No he did not. (But it looks that way.)

ASUS PB328Q

Built For Pros, Perfect For You

As the bridge between your PC and your eyes, the monitor is one of the most important components you'll purchase, but many enthusiasts end up with a subpar unit by focusing on a handful of specs, such as price, refresh rate, and native resolution. The ASUS PB328Q is a professional-grade monitor that combines multiple picture quality enhancements, ergonomic adjustability, and advanced technologies that anyone who uses a PC on a daily basis will appreciate. Perhaps most importantly, the PB328Q blends into the background and lets the games, images, websites, documents, applications, videos, and everything else you view on your PC shine through.

Raw Details

When people walk by you as you're using the PB328Q, they're likely to stop and ask you what monitor you're using and what its specs are. Tell them that this panel measures 32 inches, and the native resolution is 2,560 x 1,440 (WHQD). Compared to a 1,920 x 1,080 display, this one offers 77% more desktop space. For professionals, this means more space for tools, toolbars, and application windows, and for gamers and media enthusiasts, you can see more of the action at once. For perspective, this monitor will let you watch four 720p videos simultaneously. The PB328Q boasts a pixel density of 92ppi (pixels per inch) on this screen and features a narrow 0.277mm pixel pitch (the distance between two pixels).

With so much screen space, you can easily run two or more programs in open windows side by side, which helps keep your multitasking sessions more active and productive. Most of us sit



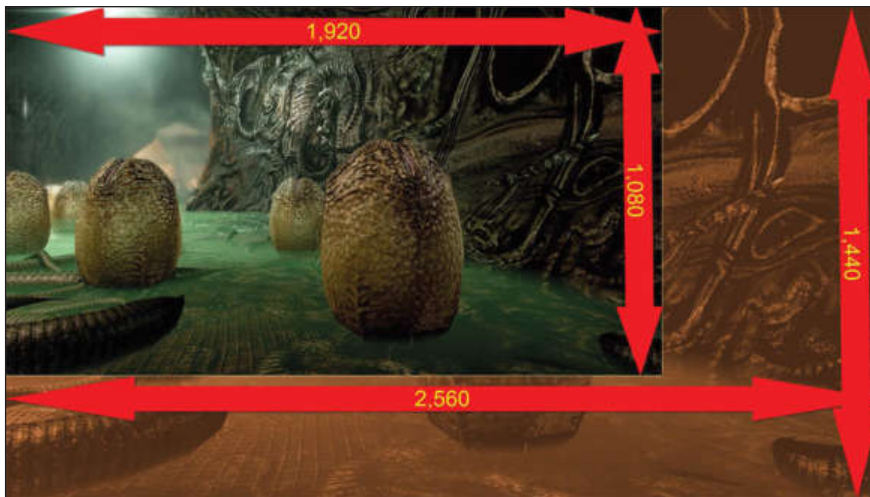
The ASUS PB328Q is a professional-class monitor with a practically invisible bezel.

directly in front of the monitor, but when sharing your screen or looking at it off center, the PB328Q's wide viewing angle, which is 178 degrees left and right (horizontal) and 178 degrees up and down (vertical), really comes in handy. This means that with this monitor there isn't as much color shifting or negative image effect you experience with monitors that feature narrower viewing angles.

Contrast ratio is another specification that has a big impact on image quality, and the PB328Q supports an impressive 100,000,000:1 ASUS Smart Contrast Ratio. This technology changes the brightness

according to the on-screen video or images, in an effort to improve the appearance of dark subject matter and make the colors look more vivid. ASUS Smart Contrast Ratio is designed for video and movie playback, but with it disabled, the monitor has a conventional contrast ratio of 3,000:1.

On the subject of colors, the PB328Q uses a VA (vertical alignment) panel, which excels at color reproduction; it supports 100% of the sRGB color space and can display up to 1.073 billion colors. The monitor also supports a 12-bit internal LUT (lookup table), which lets it reproduce images with more gradual transitions between hues,



The real estate difference between a 1,080p and a 1,440p monitor is fairly dramatic.

flickering of the backlight caused by the PWM controller that maintains the light's consistent brightness. With the PB328Q's Flicker Free feature, however, this flickering is effectively eliminated, letting you comfortably use the monitor for extended periods.

It's a well-known phenomenon that blue light can be harsh on eyes, leading to strain and even age-related macular degeneration. By selecting one of the four filtering levels on the OSD, you can reduce the amount of blue light emitted by the display's LEDs by as much as 70%.

The matte finish on this display might be one of the first things you notice, but its benefits include the ability to reduce glare in brightly lit environments and eliminate distracting reflections, which can lead to eye strain, headaches, and blurred vision. As a 32-inch display, this monitor is sure to fill your desk, but thanks to its 1.07cm bezel, you're not getting a lot of black plastic framing this device.

The aforementioned quick-release stand also supports a variety of screen adjustments to ensure the viewer's

for more true-to-life results. The LED-backlit PB328Q features a brightness rating of 300cd/m2 for vivid images regardless of the application. A 4ms gray-to-gray response time delivers smooth video playback and virtually ghosting-free gaming and 3D model manipulation.

Connectivity is another area where the PB328Q excels. There's one input for each of the following: dual-link DVI, HDMI, VGA, and DisplayPort. You can also run the included audio cable to the back of your PC for the display standards that don't support audio (DVI and VGA), and there's a headphone jack on the I/O panel in case you're in an office environment and can't get away with using the built-in 3W speakers (which for some users could eliminate the need for a set of standalone speakers). The left side of the monitor also features a quartet of USB 3.0 ports, and the monitor ships with a USB 3.0 upstream cable. The quick-release stand also conceals a 100mm x 100mm VESA mount, which simplifies connections to third-party screen mounts and stands.

The Comfort Angle

Although the raw specs of the PB328Q are impressive, they only tell a part of the story of what makes this a great monitor. If you're using

a monitor that's a few years old, then chances are good that it lacks a few ergonomic and fatigue-fighting features that modern displays like the PB328Q offer. ASUS' Eye Care Technology features, for instance, are specially tuned to ease eye strain.

Although LED-backlit monitors are extremely popular, one drawback they tend to suffer from is a barely perceptible



Being able to adjust the screen height, in addition other parameters, can really help ensure an ergonomic workspace.

comfort. There is up to 150mm of height adjustment, 60 degrees of swivel movement to the left or right from the base, and a 25-degree tilt range (-5 down, 20 up). Using these functions, you can adjust the monitor according to your exact needs, independent of other environmental factors. You can also pivot the screen 90 degrees to view it in a portrait orientation, and the OSD (on-screen display) rotates to accommodate your new view. We also like pivoting the screen like this to more easily connect the power, display, audio, and USB cables.

Image Perfection

Of particular interest to professionals in visual arts fields is the monitor's color reproduction. But in addition to a wide color palette, the PB328Q also gives users an impressive amount of manual control over the resulting image. The 6-axis color-independent control function lets users to tweak colors to suit their needs. For example, on a typical monitor where you don't have access to independent color adjustments, tweaking the green color balance will oftentimes change the appearance of white in

backgrounds. With the PB328Q, however, you can change the saturation and hue parameters of red, green, cyan, magenta, and yellow without muddying other colors.

Another color-enhancing technology ASUS adds to this monitor is its exclusive SplendidPlus Video Intelligence, which lets you cycle through five preset video modes optimized for certain types of content. The settings include Reading, Darkroom, sRGB, Standard, and Scenery. There are also two user-configurable modes that you can customize, save, and switch to on the fly.

Adjusting the monitor's settings is painless, thanks to the 5-way OSD joystick, located just behind the right edge of the panel. It lets you intuitively navigate menus and select the options you want by pressing in on the joystick like a button. Below the joystick is a column of five hotkeys, which, from top to bottom, are set as close/exit, input select, QuickFit, shortcut 1, shortcut 2, and power. The two shortcut hotkeys can be customized to perform one of nine common functions of your choice; by default they will adjust brightness and Blue Light Filter, respectively.

If you are using multiple simultaneous inputs, the PB328Q lets you see up to two sources at once, using a PIP (picture-in-picture) or PBP (picture-by-picture) image. You can also quickly and easily switch between the main and alternate sources, including swapping the audio sources.

One of the best things about having such a generous number of pixels winking at you at once is the ability to visualize things closer to their actual size. For those who are interested in seeing what their images will look like before they're printed out, ASUS offers its QuickFit Virtual Scale Function, which lets users preview several common photo (8 x 10, 5 x 7, 4 x 6, 3 x 5, 2 x 2) and document sizes (A3, A4, B4, B5, letter) on screen. Users can also use the function to align on a grid and view centimeters and inches. You can also choose from seven different colors for QuickFit backgrounds.

Business In The Front, Party In The Front

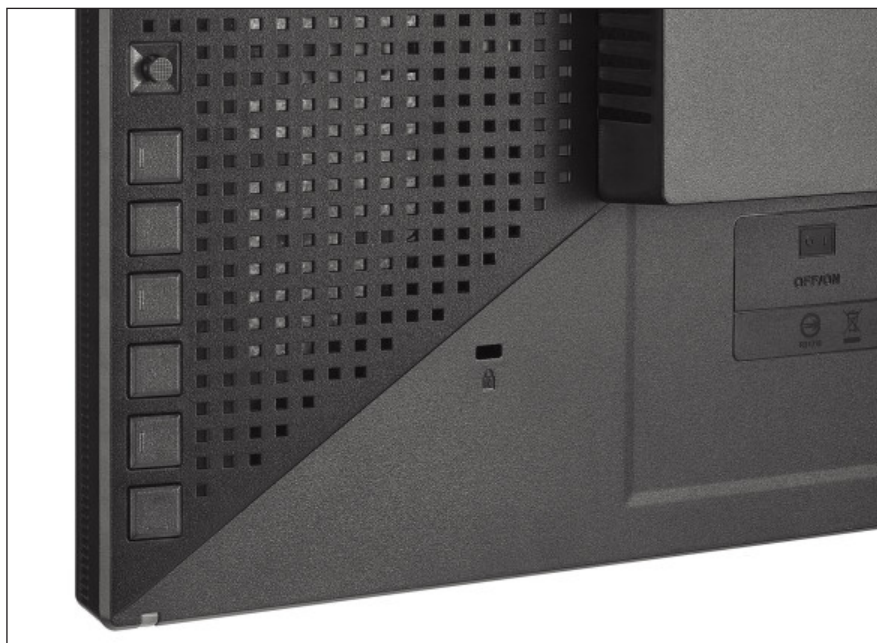
The ASUS PB328Q is a monitor that has a lot to offer your eyes. In addition to its impressive Energy Star rating and an 89.9-watt active power draw, this unit consumes just half a watt while in power-saving mode. ASUS backs it with a three-year ASUS Rapid Replacement warranty. For those in the market for an affordable professional-grade monitor capable of doing double duty for gaming and movie watching, the PB328Q is the perfect pick. ■

PB328Q

\$599

ASUS

www.asus.com



The OSD buttons give you quick access to all of the monitor's major functions.

Specs: Size: 32 inches diagonally (2,560 x 1,440); 16:9 aspect ratio; Pixel pitch: 0.277mm; Pixel density: 92ppi; Brightness: 300cd/m²; 1.073 billion colors; 4ms response time (GTG); 1.07cm bezel; tilt, swivel, pivot, and height-adjustable stand; Ports: DisplayPort, DVI, HDMI, VGA, 4x USB 3.0; 3-watt stereo speakers

Case Perfected

We Made The MasterCase 5 By Cooler Master Our Own

Between the MasterCase 5 review last month and a pair of Q&As from the prior two issues, we've given you a pretty complete picture of what modders think of this case, what we think of it, and what Cooler Master hopes you'll love about it. Rather than retread the well-worn path of what this modularity-minded mid-tower can do for you, we're going to take Cooler Master's new "Make It Yours" tagline to heart and talk about what the MasterCase 5 can do for us, as a test bed for component stressing, overclocking, and benchmarking. And along the way, we'll be pointing out much of the universal appeal of the MasterCase 5.

The Argument Against An Open-Air Bench Setup

It's true, when we're faced with reviewing five or more motherboards for a roundup on a new chipset and platform, there's nothing easier than using an open-air case, such as Cooler Master's Test Bench cases. These style cases let you simply drop the motherboard on top of a few pegs, screw it in place, and plug the CPU, memory, and graphics card into their respective sockets and slots. The PSU, storage, and optical drive tend to fit into the enclosed underside of these style cases, and you're free to wire everything up from any side. This type of enclosure isn't meant for general consumers and it's less than ideal for long term use.

But the real downside of using an open-air case, and the reason we tend to like to use standard enclosures for a majority of the component testing we do, is that the thermal performance and noise output of certain parts, such as graphics cards and CPU coolers, are impossible to gauge in real-world terms on an open-air



The MasterCase 5 chassis from Cooler Master was easy to customize to suit our purposes.

chassis. The difference between a stable overclock and a forced restart oftentimes come down to a handful of degrees, and using an open-air chassis for this purpose renders such scores and settings moot and artificial. Plus, we have a nasty habit of leaning over the system and getting our neckties caught in the fans.

As standard enclosures go, the MasterCase 5 features plenty of ventilation thanks to its mesh front and top panels. In its out-of-the-box configuration, air cooling occurs thanks to a pair of 140mm fans, one in the front and one in the back. If you opt for the MasterCase 5 Pro, you'll get a second 140mm front panel fan. We rely on large diameter fans due to their slow rotational speeds, which ensures they don't contribute much to the overall system noise. It's nice to not have to swap the factory fans

with our own. For our purposes, this case's stock cooling options are more than adequate.

There are several features on this case that make a component reviewer's life easier. One of them is the oversized cutout on the back of the motherboard tray, which simplifies the installation of CPU coolers and water blocks. There are also two cutouts along the top edge of the motherboard tray letting you position those pesky 8-pin CPU power connectors right where you need them. Of course the grommets along the right side of the motherboard (and two more in the PSU shelf panel) are generously sized. One feature you can't see in the photos of the MasterCase 5 is the rectangular cutouts behind the SSD pockets on the PSU shelf. We used these to route the front panel audio and USB port cables.



Open-air cases like this one are popular with many reviewers because of their ease of use, but we generally don't use them. We want to be able to test the thermal properties of cases as users will experience them. The same goes for noise properties when testing system components such as fans.

Now, it's a quick and smooth process to pull out and drop in motherboards.

Paint Particulars

The exterior of the MasterCase 5 is a dark metallic grey with a soft matte finish that resists fingerprints and smudges. The interior frame and drive cages are painted a matte black. The finish looks good and feels very durable. Cooler Master attributes this to its baked-on powder coating process. When you build multiple systems a month in a single enclosure, things are bound to get scraped and dinged. Although we've only built a handful of systems using the MasterCase 5, it has taken our ham-fisted fumbling with aplomb and there's nary a scratch despite several slips with a screw driver. According to Rajiv Kothari, Cooler Master's North America Regional Marketing Manager, the Master Case 5's color scheme fits with the firm's new "workshop focused" appearance. In the coming months, Cooler Master will have a slew of new products that share this consistent aesthetic.

Our Ideal Space

Because of our self-imposed limitations, we tend to cycle through cases on a fairly regular basis. One enclosure we recently sent packing was plenty spacious, but lacked much room behind the motherboard tray. As a result, it took two people to reinstall the right side panel following a PSU swap, one to apply pressure to all four corners of the side panel while the second quickly screwed it in place. Another enclosure that we'd been using without issue for months was ousted because it didn't have enough interior space to install a particularly thick radiator in the front panel, forcing us to run the cooling loop outside the case.

We spoke about the cable management conduit in the review of the MasterCase 5, but it bears repeating. Not

only is there plenty of room to install the PSU's 24-pin ATX connector, but you could even double it on itself if you cinched it in tightly using the built-in straps. The spec sheet says there's 25mm between the motherboard tray and the side panel, which is roughly the same diameter as a US quarter. That's much more space than we typically see. For us, this means that the panel goes back on without fuss whether we've taken the time to make everything look nice or hastily crammed in wires wherever they'll go to meet a deadline. Here's a dirty little secret: Most people never see the horrors that lurk behind your motherboard tray.

Good design for us starts with a case that's easy to open and install parts into. Thumbscrews are pretty common in even the least expensive cases, but the thumbscrews in the MasterCase 5's side panels, PSU bay cover, and SSD pockets feature a smooth shank before the threads and the mounting points of each panel have an elevated surface that surrounds the screw hole. This lets the thumbscrews remain attached to the part they're meant to secure, meaning we're not having to look for the screws when it comes time to reassemble the system. Captive thumbscrews, as they're commonly called, are a small touch, but one that frequent



Inside, the MasterCase 5 is roomy, black, and modular.

There's no denying the MasterCase 5's sturdiness, with the panels on or off.

system builders will appreciate on the MasterCase 5.

Clip-And-Click

We've been using ZOTAC's GTX 980 Ti AMP! Extreme Edition graphics card for a handful of our system builds lately, and this card measures more than 12-inches long, which is long enough that the drive cage doesn't fit opposite the card. In addition to the modular SSD pockets, the MasterCase 5 features a unique clip-and-click panel, which runs along the right side of the case and lets you vertically adjust the position of the ODD and HDD drive cages. Now, no matter which PCIe slot that card is installed into, we can move the drive cages out of the way.

Material Advantage

The biggest difference between a cheap case and one that caters more to the enthusiast crowd is often evident in the quality of the steel. There's no denying that a light case with thin steel can hold your components together, but we've seen some instances where the frame of a case warps once the side panels come off. One way to give thinner steel a decent amount of rigidity is to stamp a bevel into the panels.

For the MasterCase 5, however, Cooler Master used SECC steel with a thickness of 0.8mm, which lets them keep the panels flat and simply fold the edges to create the tabs that the panels use to slot into place. The case frame is composed of 0.7mm SECC steel. According to Kothari, "The quality of the steel is something we are proud of. When people actually hold/touch the case, the value is very apparent." As a result of the thicker steel, the MasterCase 5 may weigh more than you'd expect, but there's no denying its

sturdiness, with the panels on or off. Cooler Master performed some very unique in-house stress testing on the MasterCase 5, including having a 6-foot tall, 200-pound guy stand on the enclosure; it didn't flex. We also like that the edges of the panels and interior structures are soft and rounded so there's no chance of accidentally opening a vein as we work inside this case.

Although covered in plastic cowlings, the two handle-like structures on the top panel are riveted to the frame and can actually be used to lift and move the case, even with a full system installed. The average non-LAN-attending power user may not have need of handles on her case, but in our testing area, if it doesn't have handles, we're likely to drop it.

Never Settle

As we mentioned in the review, you can modify the MasterCase 5 and the MasterCase 5 Pro by buying modular upgrades (or downgrades as the case may be) at www.cmstore-usa.com/accessories. For instance, the vanilla MasterCase 5 has two SSD pockets and space for two SSDs on either the top of the PSU partition, or behind the motherboard tray, but if you want to add a third or fourth SSD without bogarting your 3.5-inch drive cage, Cooler Master will sell you a couple additional SSD pockets for \$4.99 apiece. For our test systems, we like to keep SSDs handy with clean versions of Windows 10, Windows 8.1, and Windows 7, as well as a large 3.5-inch 3TB HDD available for overflow, so we used the two SSD pockets that came with the MasterCase 5 on top of the PSU shelf, and installed the HDD and third SSD into the 2-bay HDD cage. If we're running multiple graphics cards, we can just as easily move that drive cage to the PSU area.

We tend to use a closed-loop liquid cooler for CPU testing, and we've installed a 240mm radiator into the top panel thanks to the optional MasterCase 5 Top Cover



We love the SSD pockets that Cooler Master uses (top), and the top cover kit is a must-have upgrade.



This 3.5-inch HDD drive cage (left) supports two drives, but you can install SSDs or 2.5-inch HDDs in each tray as well. If you're getting serious about storage, go with the MasterCase 5 Pro, or upgrade with the 3-bay drive case accessory (right).

Kit (\$16.99). Of all the upgrades available, this one is a must-have for us. Incidentally, there's also room for a 240mm or 280mm radiator in the front panel (Cooler Master reports that if you're creative enough, you can even get a 360mm rad up front) and a 140mm or 120mm radiator on the back panel, which is handy as more and more graphics cards are shipping with all-in-one closed loop liquid coolers.

Other accessories that were available for preorder as we went to press include a two-bay 3.5-inch HDD drive cage (\$12.99), a three-bay version (\$14.99), and the Side Window Kit (\$24.99), which gives you a very generous view of the interior of the case. This panel also comes with a removable tinted panel that obscures the PSU partition for a cleaner look.

Although these are the only upgrades currently available for preorder, Cooler Master has big plans for the future of its FreeForm products. For example, at PAX Prime this past August, Cooler Master showed off an attractive smoked tempered glass side panel with a lock. The firm is also looking to add liquid-cooling reservoir/pump mount holders that fit onto the clip-and-click panel, which is a boon for

enthusiasts looking to install some serious custom liquid cooling, but not so much for companies that sell those VELCRO pads.

Other add-ons Cooler Master is looking to implement include vertical

GPU supports, fan brackets, radiator brackets, a front door cover with silent padding, and alternative panels for the top and sides of the MasterCase 5. Another trend that Cooler Master plans to adopt is the release of 3D models of the MasterCase 5 and its accessories, letting users with 3D printers and CAD software modify the designs and manufacture their own parts. Kothari explained that Cooler Master is looking to build on these community-inspired modifications and mass produce and sell the most popular ones, so all MasterCase 5 owners can reap the rewards of the maker movement.

Does A Perfect Case Exist?

To be clear, there's no such thing as an objectively perfect case. Any feature that appeals to one group of users may be the thing that keeps another group of people from giving it a second look. Cooler Master knows that they can't make everyone happy with one case, which is why the MasterCase 5 is more a foundation and a starting point. It's up to you to make the finishing touches, and that's what we love about it. ■



The windowed side panel kit comes with another removable tinted panel that lets you optionally obscure the PSU bay if you are going for a cleaner look for your build.

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Windows 10 Tips: Special Destination Folders

Despite the early praise it has received in the press, many are still holding off on installing Windows 10. As we've illustrated in the past couple of issues, however, performance and ease of installation are two ways Win10 won't disappoint users of Microsoft's previous OSes. In this month's article, we set out to determine if Win10 is just as tweakable as Win8.1 and Win7.

The ability to create special destination folders that contain one or more settings adjustments was one of our favorite tweaks from the previous OS. Although Win8/8.1 needed all the help it could get in letting users modify the layout and appearance of the UI, Win10 supports these useful folders as well. Win10's vastly improved interface resolves many of Win8/8.1's biggest gripes, but the functions these special destination folders expose go beyond UI enhancements and offer power users scores of ways to pull off complex functions and deeply buried tasks with a simple double-click. Best of all, creating destination folders is as simple as creating a new folder and typing a long string of alphanumeric characters in the Name field.

Enabling God Mode

Easily the best shortcut you can create is the God Mode folder, which is a special destination folder you can add to your Desktop, Start menu, or anywhere else. It features a couple hundred settings, low-level tasks, administrative tools, and tweaks that you can perform and adjust with a simple double-click of your mouse.

When talking about the God Mode folder previously, we mentioned that to get it and the rest of these special folders to appear, you need to adjust your folder settings to enable hidden items and



The God Mode folder doesn't look like much before you press ENTER.

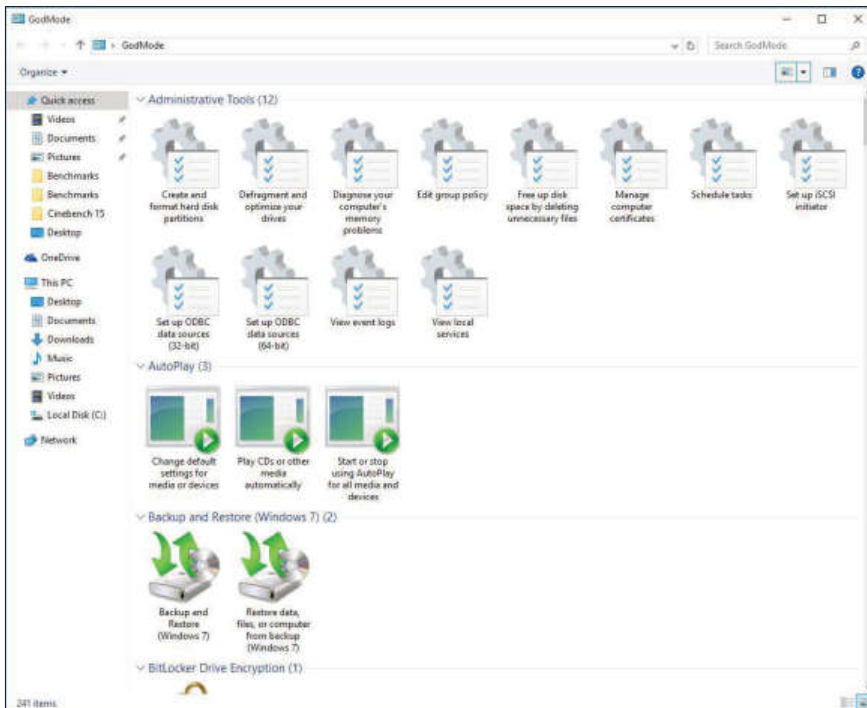
file extension display. This step wasn't necessary on our test system running Win10 Pro, but if your folders don't show up correctly, launch File Explorer, click the View tab, and click the checkboxes adjacent to File Name Extensions and Hidden Items to perform this step.

To create the God Mode folder, right-click an empty spot on the Desktop and click New, Folder. In place of the folder's name, type **God Mode.{ED7BA470-8E54-465E-825C-99712043E01C}** and then press ENTER. The generic folder icon will be replaced by the same icon used for the Control Panel. When you double-click this folder, though, you'll find more than 200 handy operations you can execute by simply double-clicking them. The operations appear in categories, which are listed alphabetically, starting

with Administrative tools, followed by AutoPlay, Backup And Restore, and so on. Double-click Create And Format Hard Disk Partitions, for instance, to launch the Disk Management window.

The number of functions will vary depending on the version of Windows you're running, but the God Mode folder on our Win10 Pro system displayed 241 items, while the Win7 Enterprise-based God Mode folder features 281 items.

It's true, scrolling through 241 items to find even an occasionally useful item is arguably more work than is necessary, but you can click and drag a handful of the most useful functions to someplace convenient such as your Desktop or Start menu. As you can see, this is a neat trick, but if you're like us, you're probably wondering how it works and



This is what the God Mode looks like on the inside.

why Microsoft would hide such a useful function in Windows.

God Mode Demystified

God Mode is actually just a folder that points to a special destination, in this case, the Control Panel. Those 241 functions are all accessible from the Control Panel, but they're buried under categories, subcategories, and hyperlinks. According to Microsoft, the God Mode folder is merely one of many undocumented features designed to give developers direct access to a variety of Windows' settings and core functions.

The long string of characters within the curly brackets is referred to as a GUID (globally unique identifier), which Microsoft created to let developers use these destinations in an API call, or a command-line instruction. Microsoft first started using GUIDs and their Plain English translations, or canonical names, in Vista. As of Win7 and Windows Server 2008 R2, administrators can use these GUIDs and canonical names

in a Group Policy to hide individual Control Panel operations.

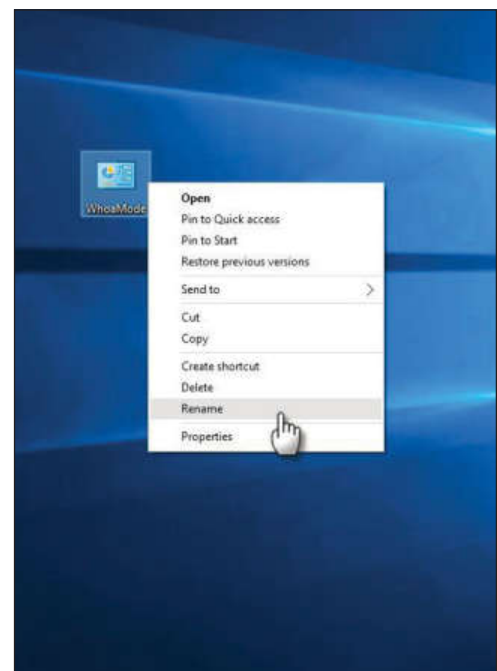
This destination isn't officially called God Mode, either. You can name it anything you want; just type your preferred folder name before the period and then insert the relevant CLSID key (a globally unique 128-bit hexadecimal number that identifies a COM class object) within a pair of braces or curly brackets. For instance, replacing the folder name with **CPU.{ED7BA470-8E54-465E-825C-99712043E01C}** will create a Control Panel folder named CPU. Another cool tidbit Microsoft revealed is the fact that you can use CLSID keys to create a number of useful special destination folders to take greater control of your overall computing experience.

Alternative Special Destination Folders

Although the God Mode folder we describe above is one of the most

useful CLSID key folders we found, there are others. For each of the following, simply create a new folder and type the CLSID key exactly as listed, preceded by a name that best describes the folder's function and a period. In the examples below, we list our own descriptive folder names, but feel free to change them wherever you see fit. We'll also mention whether the special destination folder works in Win7 or Win8/8.1 in addition to supporting Win10. Keep in mind that your mileage may vary with these shortcuts. For each special destination folder that follows, the folder's name and canonical CLSID string—everything you need to rename a folder—will appear in bold and a brief description will follow. (Be sure to leave off the period after the closing curly bracket.)

Power Plan.{025A5937-A6BE-4686-A844-36FE4BEC8B6D}. This special destination folder works in Win7, Win8/8.1, and Win10. It gives you instant access to your computer's power plan selection screen. Use the radio buttons to switch between the Balanced and Power Saver profiles

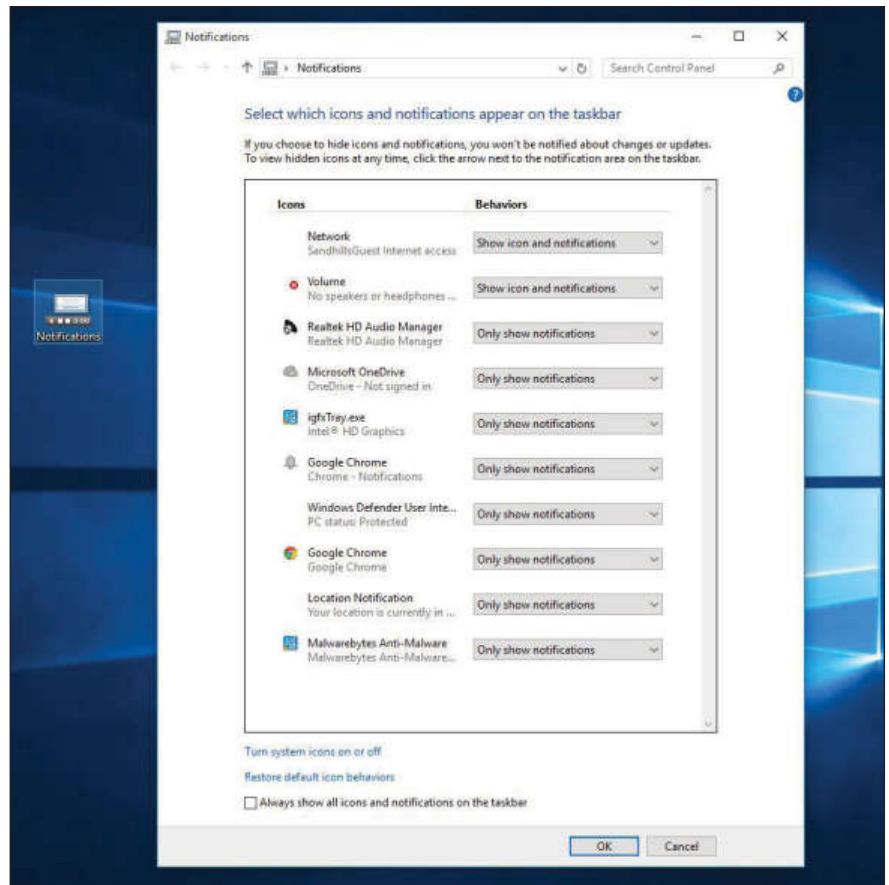


Not a fan of using God Mode as a folder name? You can name special destination folders anything you want.

or click the Change Plan Settings hyperlinks to manually tweak the brightness levels and change the amount of idle time that passes before the screen dims, the monitor turns off, and the computer goes to sleep. This special destination folder would be particularly useful for notebooks.

Notifications.{05D7B0F4-2121-4EFF-BF6B-ED3F69B894D9}. Once created, this folder lets you modify the notifications that appear in the Taskbar's notifications area. You can scroll down the list to see all applications that are capable of generating notifications and use the drop-down box on the right to Show Icons And Notifications, Hide Icons And Notifications, and Show Only Notifications. Hyperlinks at the bottom of the Control Panel also let you turn system icons on or off and restore the notifications to their default settings. This special destination folder works in Win7, Win8/8.1, and Win10.

Vault.{1206F5F1-0569-412C-8FEC-3204630DFB70}. To get quick access to settings that let you take greater control over the saved log-on information for websites, connected applications, and networks, create a new folder and name it. This works in Win7, Win8/8.1, and Win10. From here, you can view



The Notifications folder lets you quickly tweak how Windows and other applications notify you.

passwords, edit credentials, and remove saved accounts.

Install From Network.{15eae92e-f17a-4431-9f28-805e482dafd4}. This special destination folder works in Win7, Win8/8.1, and Win10 and lets you quickly access an area you can use to install programs from a network location.

Default Programs.{17cd9488-1228-4b2f-88ce-4298e93e0966}. By creating a Default Programs special destination folder in Win7, Win8/8.1, and Win10, you can quickly access the list of default programs Windows uses for common tasks such as browsing the Web, playing back or ripping CDs, and identifying which file types are associated with which applications.

Assembly.{1D2680C9-0E2A-469d-B787-065558BC7D43}. Use this to create what amounts to a shortcut to the Assembly folder (C:\Windows\Assembly) in Win7, Win8/8.1, or Win10. The Assembly folder contains common libraries that can be used by any application that leverages the .NET Framework. This unique view of the shared libraries lets users find data about the assemblies stored here and quickly perform operations that are typically only accessible from within an assembly. For instance, you can right-click any one of the assemblies here and click uninstall (though we would not recommend doing so without cause).

Network.{208D2C60-3AEA-1069-A2D7-08002B30309D}. If you want to create a quick shortcut to the File Explorer view of your current network



These are a few of the more useful CLSID keys that we used to make shortcuts on our Desktop.

in Win7, Win8/8.1, or Win10, create this special destination folder. The name of the network (by default, this is Homegroup or Workgroup depending on your settings) appears in parentheses. [NOTE: You can name this special destination folder anything you want, but upon pressing ENTER, the folder's name will revert to Network, followed by the network name.]

C o m p u t e r .
{20D04FE0-3AEA-1069-A2D8-08002B30309D}. When you create this special destination folder in Win7, Win8/8.1, or Win10, it becomes simply a File Explorer folder that shows you the contents of your computer, like the My Computer folder or This PC folder (as it is called in Win10).

P e r s o n a l i z e .
{ED834ED6-4B5A-4bfe-8F11-A626DCB6A921}. Create this special destination folder to get quick access to Desktop backgrounds, themes, colors, sounds, and screen savers on your Win7 or Win8/8.1 computer. Microsoft has largely neutered the Control Panel's Personalization menu in Win10, so creating this special destination folder limits you to selecting a theme. Win10 users

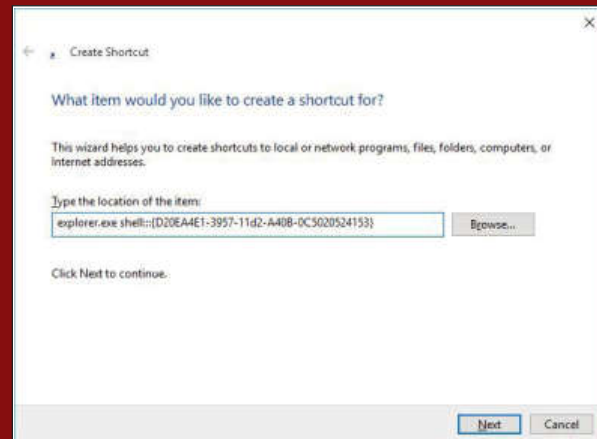
WINDOWS TIP OF THE MONTH:

Even More Shortcuts

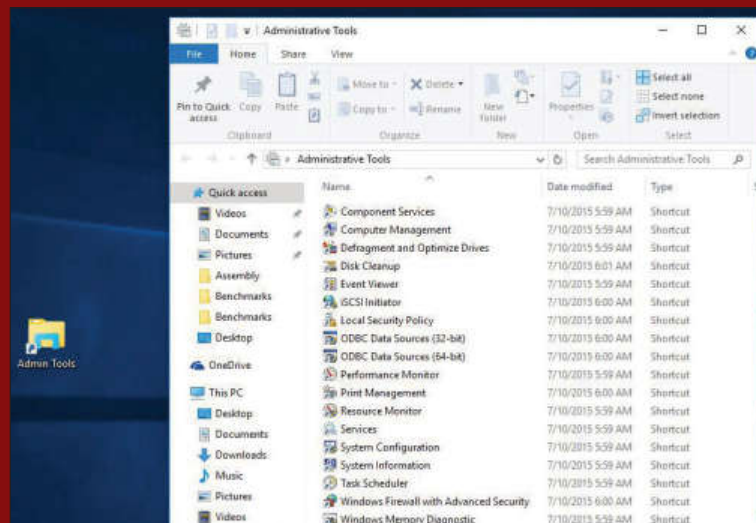
As we've shown you, CLSID keys are useful things. In this issue's TOTM, we'll show you how to create even more special destination folders, and even Desktop shortcuts (which operate essentially the same) using a complete list of GUIDs exclusive to Win10. First visit <http://tinyurl.com/qxwcdx> to see a lengthy list of GUIDs culled from the HKEY_LOCAL_MACHINE\SOFTWARE\Classes\CLSID folder in the Registry. Scroll through the list and create a few special destination folders to see how it works. We tested the Administrative Tools, Frequent Folders, and Games Explorer GUIDs, but not all of these GUIDs will convert into a working special destination folder. In these instances, you can create a shortcut with a shell command.

Start by right-clicking anywhere on the Desktop and clicking New, Shortcut. In the Type The Location Of The Item field, type **explorer.exe shell:::{GUID}**, making sure to replace "GUID" with the alphanumeric string that corresponds to the destination to which you'd like to create a shortcut. Click Next, replace Explorer.exe in the Name field with an appropriate title, and then click Finish. Although this will work with most of the GUIDs listed at that URL, there's an alternate shell command you should try if that one fails. When inputting the location, start with **explorer /e,::{GUID}**, again making sure to replace "GUID" with the alphanumeric string.

The only real difference between a special destination folder and a shell command shortcut is the appearance of the arrow in the corner of the shortcut's icon.



Make sure you copy the shell command exactly as it is here or the shortcut won't work.



Notice the arrow in the corner of our new Admin Tools icon designating this as a shortcut, not a folder.

who really want to customize their computing experiences can click Start, Settings, and then Personalization.

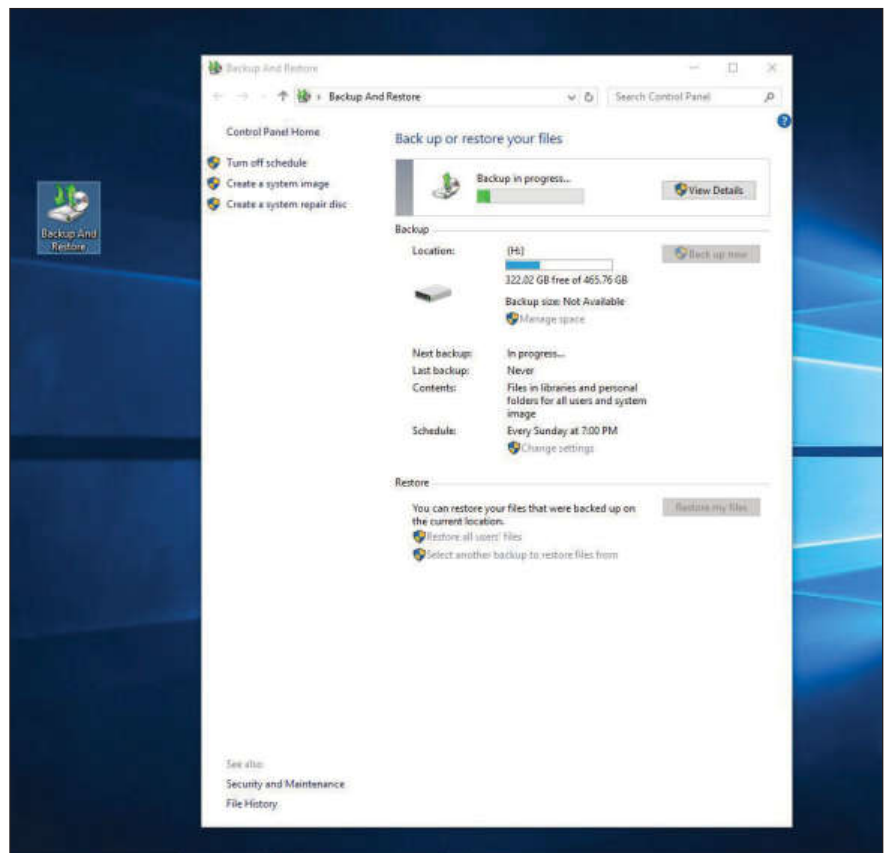
Printers.{2227A280-3AEA-1069-A2DE-08002B30309D}. To get fast access to the printer management console in Win7, Win8/8.1, and Win10, just create a special destination folder using this string. From here you can manage your installed printers, change your default printer, and add a printer using the hyperlink at the top of the page. Right-clicking any of the installed printers also lets you configure sharing, set up preferences, and more.

Manage Connections.{241D7C96-F8BF-4F85-B01F-E2B043341A4B}. Win7, Win8/8.1, and Win10 all let you create this special destination folder to access the Remote Desktop Connection Control Panel. You can click the Access RemoteApp And Desktops hyperlink in the upper left of the screen to establish a remote session using a preconfigured email address or connection URL. If there are no active remote desktop connections, this window will be empty.

Windows Firewall.{4026492F-2F69-46B8-B9BF-5654FC07E423}. This self-explanatory special destination folder, which works in Win7, Win8/8.1, and Win10, launches the Windows Firewall Control Panel item. From here you can see details about any private, guest, or public networks you are connected to and tweak the firewall settings using the hyperlinks on the left side of the window.

SyncCenter.{9C73F5E5-7AE7-4E32-A8E8-8D23B85255BF}. To bring the Control Panel's Sync Center to your fingertips, create this special destination folder. This works in Win7, Win8/8.1, and Win10.

Troubleshooting.{C58C4893-3BE0-4B45-ABB5-A63E4B8C8651}. This folder, along with the next two, will help you diagnose and fix many common PC problems. When you open the folder, you'll have access to troubleshooting options for programs, hardware, sound



The Backup And Restore special destination folder is one of our favorites.

devices, network and Internet, and security subsystems.

Backup And Restore.{B98A2BEA-7D42-4558-8BD1-832F41BAC6FD}. If you are a regular reader of this column, you'll get a lot of mileage out of this special destination folder. As you might expect, it lets you set up a backup (for the first time), create a new backup, or restore from an existing backup. From the hyperlinks on the left side of the window, you'll be able to create a system image and a system repair disc.

Recovery.{9FE63AFD-59CF-4419-9775-ABCC3849F861}. When something goes wrong, reverting to a recent restore point can be one of the best ways to get your PC back in working order. This special destination folder gives you ready access to System Restore for recovery purposes or simply to create a precautionary restore point

before embarking on another potentially risky operation.

Manage Storage.{F942C606-0914-47AB-BE56-1321B8035096}. The Manage Storage Spaces special destination folder is the only one we tested that did not also work in Win7 or Win8/8.1. From here, you can create storage pools, which effectively let you store files in two different drives. Storage pools are great for those times when a drive on your PC is getting close to full, or for storing redundant copies of important files.

Accelerate Your Control Panel

Although this month's project doesn't add any functionality to your PC that wasn't already there, creating a handful of special destination folders does give you ready access to powerful features that you may find handy on a regular basis. Everybody loves a shortcut. ■

Windows 10 Up Close

Get To Know Windows 10's Newest Features

If historical trends for Microsoft's operating systems hold to be true, Windows 10 will be the OS you'll be using for the foreseeable future. Windows 7 righted the ship after Windows Vista, which had notoriously poor support with legacy applications and drivers. And Windows XP corrected the stability issues that plagued Windows Me. When it comes to flops, Windows 8.1 (and 8.0) isn't generally perceived on the same level as Windows ME or Vista, but its "Modern UI" was never a perfect fit for those using a mouse and keyboard. On desktop PCs, people often found themselves switching between Win8.1's Modern UI and the traditional Desktop to get things done.

For those coming from Win7, Win10 is a less jarring transition than Win8.1. The Start button, for example, makes a triumphant return. Microsoft has also managed to incorporate the most useful elements of Win8.1, such as Live Tiles, into the Start menu, so you'll have quick access to both Windows Store apps and conventional programs. On the flip side, some of the least popular features of Win8.1, such as the Charms bar, are banished with Win10. In short, Win10 combines many of the most well-liked qualities of Win7 and Win8.1. There are new features, of course, too. Here, we'll examine what's new and exciting with Win10.

The Start Menu

Familiarity is important with an operating system. If you don't know how to get around, such as where to find applications and settings, a foreign interface can make for a frustrating experience. Win8.1 came with a slight learning curve, such as using mouse



Windows 10's Start menu mixes elements of other versions, specifically Windows 7 and Windows 8.1.

gestures or keyboard shortcuts to bring up certain menus, which made some users revert back to Win7. With Win10, anyone familiar with Win7 should be able to use the OS without instruction. The Win10 Desktop, for instance, offers the instantly recognizable Taskbar and System Tray, as well as plenty of open space for Desktop icons.

The Win10 interface isn't just a refined version of Win7, though. Win10 incorporates many of the ease-of-use and touchscreen elements from Win8.1's Home screen. Live Tiles, for instance, now reside in a pane alongside the Start menu, so you can view updates to email, weather, and the latest news just by clicking the Start button. Microsoft allows you to customize which tiles show up in the Start menu, and you can remove all the tiles, if you don't wish to see them. Similar

to Win8.1, you can resize each tile to best fit within the Start menu's real estate. If you find yourself doing too much Tetris-like tile organization, you can also resize the entire Start menu. Select the right-edge and drag it to the size you prefer.

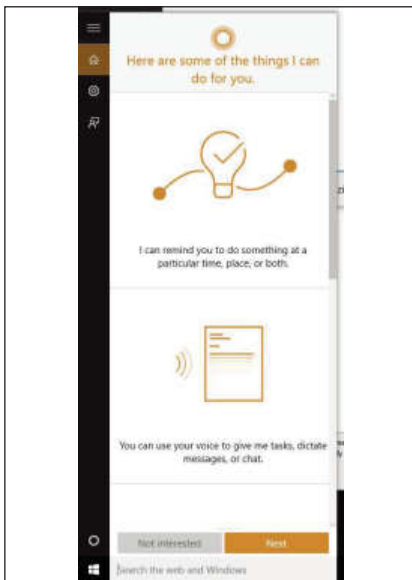
On the left side of the Start menu, Win10 displays the applications you most frequently open. You can add folders to the Start menu, such as the Documents, Downloads, and Pictures folders that were common in Win7's Start menu. To add a folder, open Settings, select Personalization, and choose the Start tab. Click the Choose Which Folders Appear On Start link and enable the folders you'd like to see in the Start menu. Clearly, the Start menu is more customizable than past Windows versions.

The Taskbar

There are two big additions to the Taskbar: Cortana search and the Task View button—both of which are located to the right of the Start button. Cortana is a virtual assistant, similar to Apple's Siri, that allows you to use your voice to search for files and open applications. If you want to make a Skype call, for example, just say "Hey Cortana, open Skype." If your PC doesn't have a microphone, you can still take advantage of Cortana via the search box. As such, you can just type what you're looking for, whether it be an installed app, file stored in OneDrive, or an online website, and select from the onscreen results.

The Task View feature is a great way to view all of your open applications, and it also lets you create virtual desktops to group like projects, so you can better organize applications

and files. Task View is similar to the ALT+TAB shortcut in previous Windows iterations, as it'll display all of your open programs. But rather than closing once you release the keys, Task View stays open until you pick an



Cortana will help you to get things done faster.

open application or dismiss it. Press the Windows and TAB keys to bring up Task View.

To create a virtual desktop, you'll just need to open Task View and click the New Desktop link in the bottom right corner. After doing so, two thumbnails representing the Desktops will appear just above the taskbar. To organize the applications, just drag-and-drop open programs from your current Desktop into the new Desktop. We're not sure how many virtual desktops Win10 is limited to, but we've created 10, which should be enough for most everyone. You shift among the virtual desktops by opening Task View and selecting the Desktop you require. The thumbnails help you to figure out which desktop you'll need. If you prefer keyboard shortcuts, you can shift among the virtual desktops by holding down the

Windows Key+CTRL+left or right arrow keys.

Power users that routinely have multiple programs open should find the virtual desktops to be a boon. For example, you could dedicate one desktop to Microsoft Office applications and the Edge browser for online research, while the other tab could have Google Chrome open for multimedia playback and other entertainment applications.

You can still pin applications and shortcuts to the Taskbar. The Jump List feature is also available for quick access to recently opened items. If you find that the buttons in the Taskbar take up too much space, Win10 allows you to use smaller icons. Right click the Taskbar, select Properties, and check the Use Small Taskbar Buttons checkbox to switch to miniature icons.

At first glance, the System Tray area appears similar to Win7 and Win8.1, but Microsoft has made some slight changes. There's a new Action Center feature that serves as one place for all system notifications, as well as quick access to common notebook and tablet settings. For instance, there are buttons to toggle on or off Battery Saver, Airplane Mode, Bluetooth, Wi-Fi, and Location. To view the Action Center, click the icon in the System Tray that resembles a speech bubble. Notifications within could consist of alarms, reminders, emails, and application alerts, among others.

There's no longer a Customization option in the System Tray pop-up, so if you want to alter when and how programs display notifications, you'll need to right-click the Taskbar, select

Properties, and click the Customize button. From there, you can control which icons appear in the System Tray, turn system icons on or off (such as the clock, network connection, or volume), and manage which applications can show notifications. To clear out the notifications, open up the Action Center and click the Clear All link in the upper-right corner.

Bleeding Edge Browser

There a couple of standout features with Win10 that power users might find intriguing. Let's start with Microsoft's Edge browser, which is more than a facelift to Internet Explorer. Microsoft started by making Edge quick, and a recent Microsoft blog post indicates that Edge outperformed Chrome and Safari in JavaScript benchmarks. Edge's address bar is also integrated with Cortana, so the OS' virtual assistant can help get things



You can adjust the width of the tiles and overall size of the Start menu in Windows 10 to fit your ease-of-access needs.

done faster. For example, you can type questions into the address bar and Cortana will display answers directly under the address bar. You can also highlight a word or phrase on a website, right-click it, and select Ask Cortana for more details about a particular topic.

Gamers will like that Win10 comes with built-in support for DirectX 12.

Another notable feature with Edge is the ability to mark, annotate, or draw on a web page. Officially known as Web Notes, the feature is ideal for those who want to highlight a key section of a website when sharing it. To use Web Notes, click the Make A Web Note button, which is next to the Favorites bar button. Web Notes offers three primary tools: a highlighter, a digital pen, and an annotation box. You can use up to all three to make notes, and you can also crop out a single area to better highlight what you want others to see. Web Notes let you store the pages inside of OneNote or you can email the note.

Microsoft Edge also comes with a Reading View feature that loads a webpage without ads and other online clutter. To activate the Reading View, click the small book icon to the right of the address bar. Some Win10 users have found that Microsoft Edge doesn't work with all websites. Edge doesn't support ActiveX, browser helper objects, and VBScript, among others, which helps Microsoft to deliver better security and quicker performance. For compatibility, Microsoft also loads Win10 with IE11. You can force a website to load in IE11 by clicking the ellipsis menu on the far right side and selecting Open With Internet Explorer.

"Microsoft Edge is still a work in progress," says Richard Edwards, principal research analyst at Ovum. "Its success is likely to be determined by new use cases, including non-traditional PC devices (hint: think HoloLens)." For reference, HoloLens is an augmented-reality headset

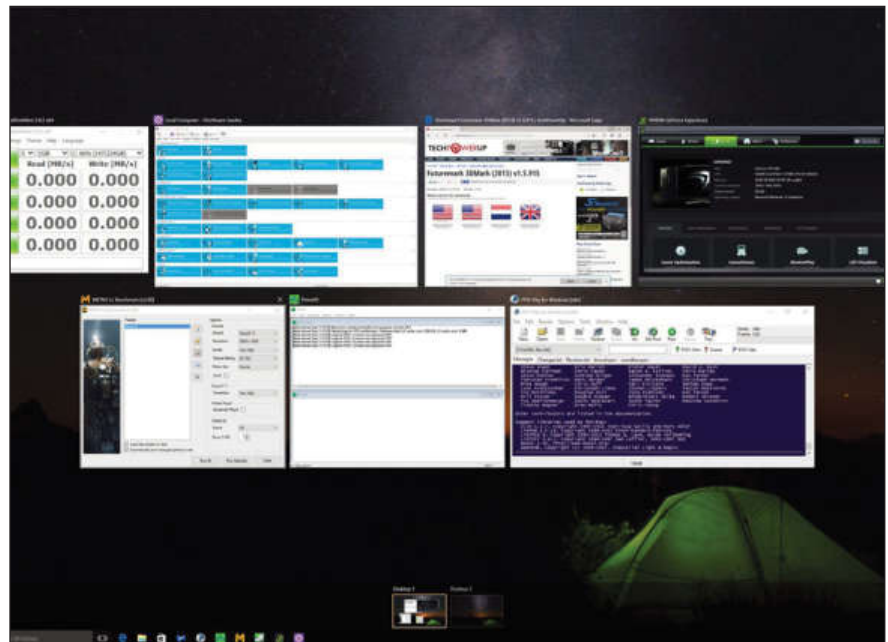
that Microsoft hopes to use for gaming, multimedia, entertainment, and educational purposes, among others.

This One Goes To 12

Gamers will like that Win10 comes with built-in support for DirectX 12,

in the game, so to speak, we've yet to see any definitive DX12 performance numbers with modern games. AMD, Intel, and NVIDIA all have created GPUs that will support DirectX 12, so Win10 users should be able to test it out when you have a game that supports it.

Xbox One owners will also like Win10's integration with the console via Game Streaming. This feature lets you play Xbox One games remotely from a Win10 computer over your home network. To utilize Game Streaming, open the Xbox app on Win10 and connect to your console. On your Xbox One, you'll also need to go into the Settings and allow for game streaming to other devices. To control



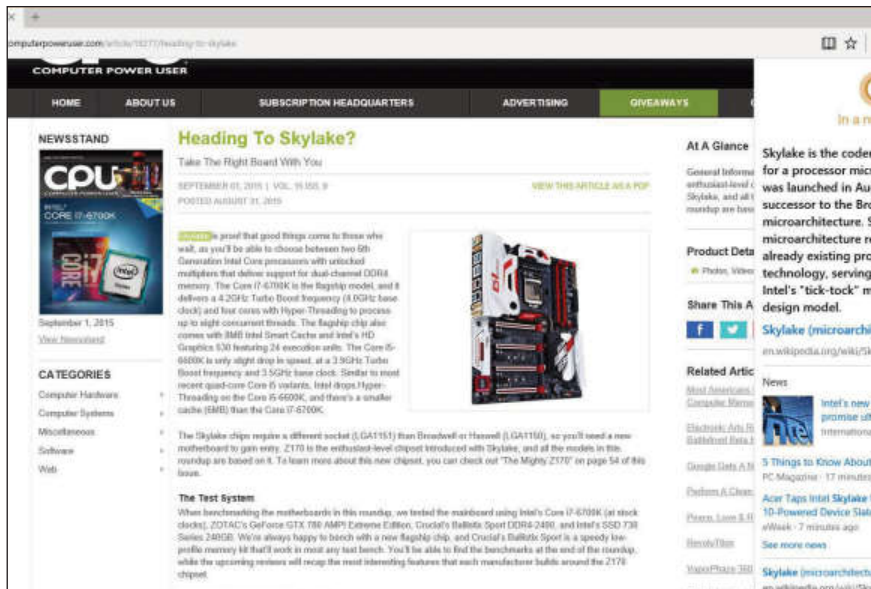
Task View allows you to see all of the applications currently open on your computer, and it's also where you can create virtual desktops.

which is a graphics API that has been designed to reduce the driver overhead that can slow down rendering, as well as to give developers more direct control over the graphics and audio hardware in your PC. We're just starting to see the first titles with DX12 support. And since it's still early

the game, you'll need to connect an Xbox One controller to your PC via USB.

Snap Assist

Earlier, we mentioned how Win10 provides virtual desktop support to organize open applications. But what if you have



Microsoft Edge also features Cortana elements, and here, we've asked Cortana to bring up information about the highlighted term "Skylake."

several applications where you'll need to compare information? In Win7 and Win8.1, you could use the Snap feature to arrange two windows side-by-side. With Win10, Microsoft introduces Snap Assist that can split the screen real estate among four applications. To set up quad windows, drag the applications you want to view to one of the four open corners of your display. With Snap Assist, you can still place programs side-by-side by dragging the application to the side of the screen. Alternatively, you can have one program that takes up half the screen and two small applications tied to the remaining corners.

File Explorer Revisions

When you open File Explorer in Win10, you'll be greeted by a Quick Access view that displays your most frequently accessed folders, as well as the most recently opened files. There's also a built-in file sharing capability, which you can find in the Share tab. OneDrive is integrated with File Explorer, too, so you can move files directly into OneDrive folders. Win10 will sync up any new content you place the OneDrive, so other devices with OneDrive access can download the file.

If your PC isn't online, Win10 syncs up the file updates when a connection is available. File Explorer icons will display if the OneDrive files on your PC are synced with online account.

Windows Update Notifications

With Win10 Home, Windows Updates will automatically download and install as available, but unlike Win7 or Win8.1, Windows won't constantly badger you about installing those updates and restarting. Instead, Win10 prompt you to schedule to restart at a convenient time. If you run Win10 Pro,

you can also set certain times where the PC restarts are off-limits.

A New Store

In Win8.1, the Windows Store was limited to apps for the Modern UI. Win10's store allows you to download full versions of desktop clients, in addition to the lightweight apps that are often designed for touchscreens. The Windows Store also offers movies, games, and music. Download options for some categories in the Windows Store are still comparatively sparse to iOS and Android, but we imagine it'll take time for software developers to put full versions of applications in the Windows Store. Of course, you can still download programs from the developer websites.

Continuum

If you've got a 2-in-1 device, or Win10 tablet that can use a mouse and keyboard, Win10 can automatically adjust its onscreen features for touchscreen input. For example, Win10 features a Tablet mode where you'll have a simplified interface filled with Live Tiles. All apps in Tablet mode automatically run full screen, and there's a back button on the Taskbar, so you can navigate back to an app's home screen or load a recently viewed web page. On some devices, such as the Surface 3 tablet, Win10 will automatically prompt you to enter Tablet mode when you remove the keyboard. You can also manually switch between modes, if you prefer one UI. There's a Tablet Mode toggle button in the Action Center that

The Upgrade Path

With most versions of Windows 7 and Windows 8.1, the upgrade to Windows 10 will be free. Here's a list of which versions are compatible with Win10, and what edition you'll be upgraded to.

Free Upgrade To Win10 Home	Free Upgrade To Win10 Pro	Excluded From Free Upgrade
<ul style="list-style-type: none"> Windows 7 Starter Windows 7 Home Basic Windows 7 Home Premium Windows 8.1 Windows 8.1 with Bing 	<ul style="list-style-type: none"> Windows 7 Professional Windows 7 Ultimate Windows 8.1 Pro Windows 8.1 Pro For Students 	<ul style="list-style-type: none"> Windows 7 Enterprise Windows 8/8.1 Enterprise Windows RT/RT 8.1

you can switch on or off to quickly move between UI modes.

Built-in Apps

Similar to Win8.1, Microsoft includes a few Modern UI apps that help you to perform common PC tasks. The Photos app, for example, organizes your photos by date and lets you touch-up the images. There's also Mail and Calendar clients. The Mail app is surprisingly robust and works with many webmail services, including

Keyboard Shortcuts

It's always helpful to know some quick keyboard shortcuts. In particular, you might want to check out the options for Snap Assist and managing virtual desktops.

Keystrokes	Shortcut Action
Windows + C	Launch Cortana into listening mode
Windows + S	Launch Cortana. Users can begin to type a query immediately
Windows + TAB	Open Task View
Windows+LEFT ARROW	Dock the active window to the left half of the monitor.
Windows+RIGHT ARROW	Dock the active window to the right half of the monitor
Windows+CTRL+LEFT/RIGHT arrow	Switch to the next or previous virtual desktop.
Windows+CTRL+D	Create a new virtual desktop.
Windows+CTRL+F4	Close the current virtual desktop.
Windows+SHIFT+LEFT ARROW	With multiple monitors, move the active window to the monitor on the left.
Windows+SHIFT+RIGHT ARROW	With multiple monitors, move the active window to the monitor on the right.

Outlook.com, Gmail, Yahoo!, as well as Microsoft's Office 365 and Exchange. Both POP and IMAP accounts are supported. When a new email arrives, or a calendar event is near, the items will appear in Win10's Action Center. The Mail app also features some rich Microsoft Word features, including the ability to add tables, pictures, and bullet points.

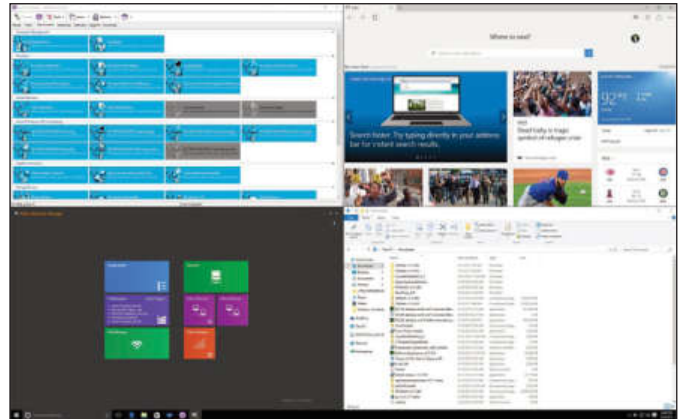
OneNote, Microsoft's digital note-taking tool, is also present in Win10. If you link OneNote with your Microsoft account, any saved content will be available through the cloud. Microsoft offers the OneNote app for Android, iOS, and Chrome. Within OneNote, you can organize content into Notebooks. The individual pages can include text, as well as hyperlinks and images, such as screenshots you capture from Edge's Web Notes.

Win10 comes with several onboard programs for music and videos. The Groove app allows you to make playlists, as well as search your digital collection by albums, artist, and songs. Groove Music Pass, of course, is also integrated, so you can listen to music streamed from Microsoft's catalog, as well as songs that you've uploaded to OneDrive. We'll note that you don't need a Groove Music Pass subscription if play music stored on your OneDrive account. To watch videos, you can load the Movies & TV app and browse through your own collection, as well as films and shows from the Windows Store (you can rent or purchase the content).

Windows Hello

The Xbox One introduced facial recognition for sign-in, and Win10

adopts this capability with Windows Hello. The caveat here is that your computer will need a RealSense camera, so you can't use just any webcam. The reason for the RealSense camera requirement is that Microsoft wants to make certain that unique



Snap Assist makes it easy to evenly split your screen among four separate applications.

personal characteristics are used with authentication. Edwards expects that Windows Hello won't be something you'll use right away. He says "The new security features of Windows 10 are dependent on new hardware, so will only come into effect when users buy new equipment." Windows Hello also works with fingerprint and iris scans. Microsoft indicates that most personal computers with fingerprint readers will work with Windows Hello.

Win10 Is A Winner

Win10 is full of incremental changes that should make it viable for desktop PC, notebook, and mobile devices. Added functionality is available, too, thanks to virtual desktops within Task View, support for DX12, and the new Edge browser. Based on initial reports, it seems that the upgrade process has been relatively error free, for the majority of users. The fact that Win10 a free upgrade (until July 29th, 2016) makes Win10 all the more appealing. ■

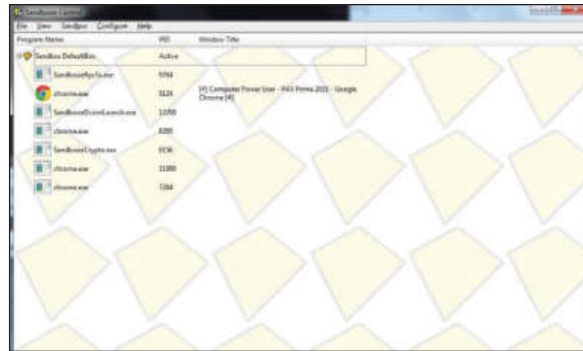
Inside The World Of Betas

INVINEEA SANDBOXIE 5.03.1 BETA

Despite our best efforts, it's extremely difficult to ever be truly safe on the Internet. We have ironclad firewalls, malware scanners with state-of-the-art heuristics, encrypted connections, and so forth, but with nefarious types regularly utilizing advanced weaponry of their own, such as XSS (cross-site scripting) attacks, even the most vigilant users can be compromised.

If we're painting a bleak picture, allow us to offer a ray of hope: Sandboxie. Protecting PCs since 2004, Sandboxie keeps malicious code from infiltrating your system's local storage; even if a user accidentally downloads malware, by using Sandboxie, the chances that malware wreaks havoc on the user's PC are greatly reduced.

Sandboxie works by creating a digital holding pen of sorts (or sandbox, if you will). Applications that run within Sandboxie are unable to write data to local storage the way that they're able to when



running unrestrained. Instead, they write data within Sandboxie, which looks the same to the applications as the operating system. Once you're finished with your sandboxed session, you can flush the data that's "written," and it vanishes into thin air.

Clearly, web browsers are a prime candidate for taking advantage of Sandboxie's skill set, but the program is far more capable than simply making Internet

Explorer/Chrome/Firefox safer. Office apps, PDF readers, instant messaging clients, and many other programs that frequently serve as attack vectors can also run within Sandboxie.

With any security software that's in beta, we wouldn't recommend using version 5.03.1 Beta as your first line of defense. Instead, grab the stable version and use the beta as a way to check out what's on deck for Sandboxie. ■

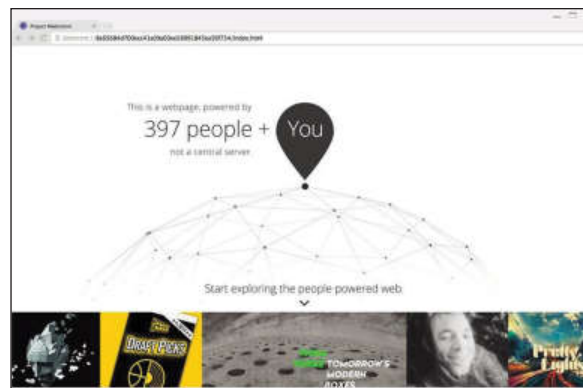
Sandboxie 5.03.1 Beta
Publisher and URL: Invincea;
www.sandboxie.com
ETA: 2016
Why You Should Care:
The Internet is a scary place.
Sandboxie makes it a little safer.

BITTORRENT PROJECT MAELSTROM BETA 42.0.1.59

Torrenting doesn't always have the rosiest of reputations. After all, when someone says he "torrented last night's episode of 'The Walking Dead,'" we know exactly how much he paid to watch it. Seedy activity like this is always going to be a part of torrenting.

That said, torrenting itself isn't inherently evil. There are plenty of sites that deal in torrenting content legally, and companies that have to regularly serve their clients with colossal amounts of data can use the underlying technology to both ease the strain on their servers and distribute content much faster. Blizzard Entertainment's Blizzard Downloader is a good example of the latter.

Now, with the introduction of Project Maelstrom, BitTorrent, the company that invented and maintains the eponymous protocol, wants to bring the same concept to web browsing. The idea is simple: Rather than relying on a single, centralized server to store a web page/site, the site owner can



seed pieces of the site to individuals using Project Maelstrom. With the site massively distributed, it can be delivered much faster to other Project Maelstrom users.

Clearly, it's going to take a critical mass of individual Project Maelstrom users in order for BitTorrent's plans to come to fruition, and a fair amount of responsibility rests with web developers. To that end, BitTorrent

has released a publishing tool that will let web devs make their sites torrent-able. In the meantime, Project Maelstrom uses a Chromium motor under its hood, so it has no problem accessing websites the old-fashioned way. So although you could be in for a letdown if you're expecting explosive performance, Project Maelstrom is sitting on a powder keg of potential. ■

Project Maelstrom Beta
42.0.1.59
Publisher and URL:
BitTorrent; project-maelstrom.bittorrent.com
ETA: TBD
Why You Should Care: Project Maelstrom could change not the way we surf the Internet, but the Internet itself.

700 VX 500



ACTIVE PFC



**LOW IN
PRICE,
BIG IN VALUE!**

AC INPUT	100-240VAC 9/4.5A 47-63Hz				
DC OUTPUT	+3.3V	+5V	+12V	-12V	+5Vsb
MAX CURRENT	22A	18A	54A	0.3A	2.5A
TOTAL COMBINED WATTAGE	130W 648W 3.6W 12.5W 700W				

AC INPUT	115/230VAC 10/5A 47-63Hz				
DC OUTPUT	+3.3V	+5V	+12V	-12V	+5Vsb
MAX CURRENT	18A	16A	38A	0.3A	2.5A
TOTAL COMBINED WATTAGE	120W 456W 3.6W 12.5W 500W				

Be cool! Be Aerocool!

AeroCool



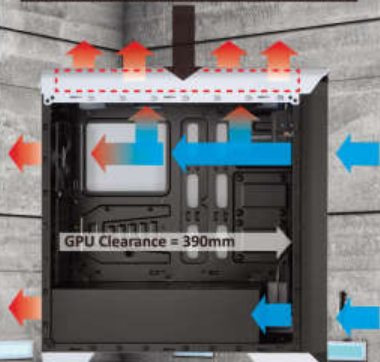
AERO-800

Stunning Industrial Design with State of the Art Airflow Performance



Black version

Extended space for watercooling



White version

For Product Details and Where to Buy, please visit: www.aerocool.us

Upgrades That'll Keep You Humming Along

This month, we're focusing on your screen (well, not *your* screen, because that would be creepy). One of our featured apps lets you take command of your on-screen windows. Another lets you create videos of your desktop. Yet another captures your gameplay footage for broadcast to your adoring fans.

SOFTWARE UPDATES

Icecream Apps Screen Recorder 2.5

This lightweight program lets you capture either a portion of your screen or all of it, recording a video file (obviously) or taking a screen shot; it receives a high-definition update with version 2.5. Now, users can record in full HD at 25fps. The update also improves multimonitor support logic and corrects glitches associated with audio synchronization and webcam use. Although it shouldn't be a concern for most users, Screen Recorder 2.5 drops support for Windows XP.

www.icecreamapps.com/Screen-Recorder

Mirinsoft CloneApp 1.07.44

After a flurry of updates in July, CloneApp gets a pair of updates in September. Version 1.07.44 optimizes the Select Installed function, updates its documentation, and adds support for Windows Public folders (Music, Pictures, Videos, Documents, Desktop, Downloads). Version 1.07.427 changed rules for some of CloneApp's Custom "Special" Variables; added support for Total Uninstall, Windows Libraries, and Recuva; and more.

www.mirinsoft.com

Nurgo Software AquaSnap 1.15

Windows' Aero Snap feature has long been one of our favorites, and AquaSnap is even better. AquaSnap gives you tremendous control over your windows, letting you snap them to quadrants on the screen, snap them to each other,

move snapped-together windows as one, tile windows together and dynamically adjust them, etc. With the introduction of AquaSnap 1.15, the Free and Pro versions are now bundled together in the same MSI package. In addition to fixing a bug that occurred when AquaSnap runs with admin rights, the latest version resolves a few issues using AquaSnap with Win10.

www.nurgo-software.com

Skype For Windows Desktop 7.10

Clearly, Skype needs no introduction. Recent updates fixed bugs, improved stability, and so forth, but version 7.10 makes life a lot easier for Win10 users in Tablet Mode. All of Skype's forms are now touch-aware, and input fields should automatically launch the on-screen keyboard. (Additionally, the Skype window will automatically adjust its size in order to make room for the on-screen keyboard.) This update also includes general fixes, according to the release notes.

www.skype.com

VSO Software ConvertXtoDVD 5.3.0.24

Despite turning 20 this year, DVD has proven surprisingly resilient in the face of both Blu-ray and digital distribution, so having software that can convert a variety of video formats to DVD, such as ConvertXtoDVD, can come in very handy. The latest update fixes a bug that would introduce background audio into menus even if "No Audio" is selected. Previous updates

over the last few months have squashed several other bugs.

www.vso-software.fr

Xsplit Broadcaster 2.5.1509.0807

A favorite of videogame live streamers, Xsplit Broadcaster makes it easy to blast your in-game action around the world via Twitch, YouTube, and other streaming platforms. This big update should make Xsplit users very happy, as it includes a couple of big changes. For starters, Xsplit Broadcaster receives a brand-new UI that, according to Xsplit, "improves usability for professional production." Tridef Smartcam support lets streamers eliminate the background behind themselves without resorting to chroma key trickery. The update should also deliver improvements on systems that use SLI or CrossFire, and a whole colony of bugs has been wiped out.

www.xsplit.com

DRIVER BAY

NVIDIA GeForce Game Ready Driver 355.82

A pair of highly anticipated AAA games, Metal Gear Solid V: The Phantom Pain and Mad Max launched in September. If you picked up either of these for the PC and you have a GeForce graphics cards (400 series or newer), then you have to have this driver. Although most GeForce drivers improve performance in a host of games, NVIDIA focuses exclusively on the above two titles for this driver, which should deliver the best possible GeForce performance.

www.nvidia.com

The Dawn Of Drones

Massive Potential vs. Genuine Concerns

Part robot, alien, and animal, drones ooze a futuristic coolness that's impossible to ignore. The present-day view they provide into how robotics will impact our future lives is exhilarating—for some of us. That same view terrifies others, and it's that dynamic that currently typifies drones. These are extremely divisive devices that are a big, fat magnet for controversy. On one hand, they're aiding in rescue and relief efforts, helping researchers and scientists gather new data, and opening new economic opportunities for companies. On the other hand, drones stir up numerous safety, security, privacy, and ethical issues that are drawing a long, cautious stare from private citizens, law enforcement, the Federal Aviation Administration, legislators, wildlife experts, and many others.

Even if you eliminate from the conversation the controversy concerning military use of drones, a segment of society is at minimum leery of a world in which flocks of autonomous drones buzz overhead and at maximum is in favor of banning drones from certain settings and situations. Numerous drone sightings near airplanes and airports, a drone crashing on the White House lawn, a Connecticut teenager attaching a handgun to a drone and firing it in-flight, and drones interfering with California firefighters' efforts in battling wildfires are a few examples why.

Still, the current popularity of drones is soaring seemingly straight up and is expected to continue in coming years. That's because of the massive potential drones have in militaristic, commercial, educational, industrial, journalistic, entertainment, and other applications. For recreational users, the technological advances drones are making scream "exploration and adventure." For companies, enhanced access,



Both startups and established drone companies have received increased attention from investors of late. Intel, for example, recently invested \$60 million in drone manufacturer Yuneec.

efficiency, data-gathering capabilities, and cost-saving drones enable "innovation and opportunity."

If projections hold true, millions of drones will be among us in the near future. Already, pro-drone hobbyist groups, aviation organizations, venture capitalists, and throngs of companies seeking FAA approval to use drones commercially indicate there's no turning back with drones. As Alan Phillips, DroneLife.com CEO, stated in an April 2014 editorial that still holds true today: "We are on the doorstep of a new and very large industry, one that will be boundless in the industries that it impacts." As Phillips wisely added, many eventual applications that drones will enable haven't even been thought of yet.

Before a day arrives when drones travel on "highways in the sky" above us, however, there are serious questions to answer, regulations to enact, and a public to educate.

The Promise Of Drones

"Drone" simply refers to an unmanned aircraft that flies autonomously or is piloted remotely. Technically, drones are known as UAV (unmanned aerial vehicles) and UAS (unmanned aerial systems). Size-wise, models range from toy-like micro "quadcopters" to highly advanced, multimillion-dollar units on par with small aircraft. The sUAV/sUAS (small UAV/UAS) consumer drones most people are familiar with include budget, mid-tier, and prosumer/professional models ranging from \$50 or less to well more than \$1,000. As Brian Markwalter, senior vice president of research and standards at the Consumer Electronics Association, says, consumer drones range from simple indoor radio-controlled quadcopters to costlier outdoor models featuring 4K Ultra HD cameras, programmable flight paths, and "follow me" functions.

Interestingly, the FAA Modernization and Reform Act of 2012 classifies unmanned, remotely piloted vehicles flown in the United States for recreational/hobbyist purposes as “model aircraft” (though upcoming regulations from the FAA for drones will likely fold in regulations for model aircraft, as well). Generally, drones fall into military, civil (government), and consumer categories. The consumer category includes drones suitable for hobbyist/recreational and commercial purposes, with “recreational” essentially meaning flying a drone for personal enjoyment, such as taking aerial photographs. Consumer use would entail selling those photographs for profit. Currently, using drones commercially in the United States is essentially banned without possessing an FAA exemption or COA (certificate of authorization). This, too, is likely to change soon. (More on this later.)

The positives concerning drones are numerous and impressively diverse. High-resolution cameras, Internet connectivity,

location-based abilities, live data feeds, and other features make drones adept at search-and-rescue tasks; aerial video and photography; surveying (such as crops, ranches, irrigation systems, forests, and storms); patrolling (borders, beaches, companies, and households); 3D mapping; inspection (towers, buildings, rooftops, pipelines, and remote equipment); tracking (wildlife and storms, for example); entertainment and advertising (films and television, sports, and concerts); news coverage; delivery; and much more.

Markwaller notes, for example, that Switzerland is currently testing drones for postal delivery that could lead to one-day deliveries of critical materials. Michael Blades, aerospace and defense senior industry analyst at Frost & Sullivan, says drones can perform numerous “dull, dirty, or dangerous” jobs compared to manned aircraft, satellite imagery, or human inspection that’s traditionally more expensive and/or dangerous. “Many

of these applications can not only be done by drones more cost effectively but more precisely and efficiently,” he says.

Tom McMahon, vice president of advocacy and public affairs at AUVSI (Association for Unmanned Vehicle Systems International), says many people don’t fully understand the unlimited potential drones offer the economy and society, whether by assisting first responders, advancing scientific research, or helping farmers more efficiently spray crops. In past statements, the AUVSI has noted UAS “are capable of saving time; saving money; and, most importantly, saving lives.” An AUVSI study forecasts the UAS industry will create 100,000-plus jobs and have an economic impact passing \$82 billion within 10 years of integrating UAS into the airspace. The association expects those numbers could go higher with the right regulatory environment.

Investment firm KPCB estimates drone shipments will hit 4.3 million this year

Intel Gets Real About Drones

At CES in January, Intel CEO Brian Krzanich detailed a collaboration with drone maker Ascending Technologies to develop avoidance technology for drones based on the Intel RealSense camera system and Ascending Technologies AscTec Trinity auto pilot system. Krzanich stated that the real leap the drone industry has been waiting for is literally giving drones sight to increase autonomy and safety. To showcase the ability for a drone to “see, react, and even move through” an environment, Krzanich and others demonstrated an AscTec Firefly drone manned with RealSense cameras flying automatically through an obstacle course.

In September at the IFA trade show, Kirk Skaugen, senior vice president, general manager of Intel’s client computing group, displayed a drone navigation system integrating six RealSense cameras for drones that enables 360-degree vision and 3D and depth data. A RealSense camera module weighs about 8 grams and measures less than 4mm

thick but reportedly brings depth perception to drones flying indoors and outdoors with little impact to payload and flight times. Ascending Technologies plans to use the obstacle-avoidance technology it develops with Intel to enable a new level of safety in future products. “Drone operators and businesses relying on drone services will largely benefit from the unprecedented simplicity and safety of drone operations close to obstacles using this new technology,” the company states.



with \$1.7 billion in projected revenues, a 167% increase from 2013. CB Insights, meanwhile, reports drone-related startups have already attracted a record \$172 million in equity financing this year. Intel, for example, recently invested \$60 million in Chinese drone maker Yuneec, marking Intel's third reported drone investment. "We've got drones on our road map that are going to truly change the world and revolutionize the drone industry," stated Intel CEO Brian Krzanich.

Blades says declining prices for drone technology, coupled with increasing technical abilities (automation, sensors, and flight times, for example), are driving the drone market's expansion. "This is due to Moore's Law and competition driving down the size and manufacturing costs of computer processors, transmitters/receivers, etc.," he says. Another enabler is the stable flight control being programmed into readily available hardware, something the industry has built

up quickly to make flying safer and easier, Markwalter says. "Drones already incorporate GPS, Bluetooth, and Wi-Fi. In the long run, small commercial UAS will be integrated with our national airspace and use some of the same location systems that manned aircraft use today," he says.

Going Commercial

Drones are expected to really excel in commercial use. ABI Research predicts the overall sUAS market will top \$8.4 billion by 2018, and the commercial sector will "dominate" the overall market with \$5.1 billion in revenue by 2019, five times that of the hobby/prosumer sector. Tractica

Research forecasts global commercial-grade UAV shipments will increase from 80,000 this year to 2.6 million-plus annually by 2025. During that stretch, annual revenue from commercial drone hardware sales will reach about \$4 billion, says Clint Wheelock, Tractica Research managing director. Commercial drone services will reach \$8.7 billion annually.

Tractica believes commercial drone applications fall mostly into aerial

"emerging, yet dynamic, technology market," Wheelock says. Most vendors, for example, are startups with products spanning airframes, accessories, data analytics, apps, and insurance. Despite lingering regulatory and technological uncertainties and some vendors waiting to fully launch their products, there's considerable talk of drone investment opportunities, Wheelock says.

Similarly, Blades believes the drone market will still be forming in five years, with the regulatory environment and privacy laws influencing growth. Conservatively, he estimates 20% growth annually. "High estimates would be 100% per year on the platform side, depending on the cost of the platform—commercial use drones can go from \$500 to \$750,000," he says. The world's leading drone maker, DJI, owns 70% of the market and is a good gauge of how hot the market is, Blades says. The company's sales tripled from 2013 to 2014 and are



Although Amazon.com's Prime Air project has yet to lift off in the United States, at least in part because of current FAA rules concerning the commercial use of drones, the company has reportedly been testing drones overseas with the eventual aim to deliver packages to customers via drone.

imagery or data analysis groups. The former includes everything from aerial footage to digital elevation maps using geo-referencing capabilities. Data analysis-centric drones possess data-collection and image-processing capabilities that enable "minuscule measurements," such as detecting water quality faster and cheaper than if using low-flying aircraft. Short-term, Tractica projects the film, agriculture, media, and oil and gas industries will lead the commercial drone sector.

Overall, the entire drone market is still a nascent one. The commercial market demonstrates classic traits of an

expected to double this year from about \$500 million to \$1 billion, he says.

But the drone market is more than drones; it includes the information that drone sensors collect and how that's processed into actionable end products. "For example, a farmer won't want a picture," Blades says. "He'll want a detailed plan on where to water, spread fertilizer, etc." Blades says drones will increasingly be part of the IoT (Internet of Things) in terms of gathering and making data available to multiple users/customers via cloud services. In 10 years, he says sensors and enterprise software will drive most changes, and the main

competition will be between companies offering DaaS (drones as a service).

The Concerns

Arguably, no company is as associated with commercial drone use as Amazon, which unveiled a Prime Air project in 2013 with the aim of delivering packages via sUAVs to customers in 30 minutes or less. Amazon CEO Jeff Bezos recently stated that one day “Prime Air deliveries will be as common as seeing a mail truck.” In a whitepaper, Amazon details a segregated air-traffic system that designates airspace below 200 feet as a “low-speed localized traffic” area reserved for “terminal non-transit operations” (surveying, videography, and inspection) and “lesser-equipped vehicles,” or those lacking sophisticated sense-and-avoid technology. A “high-speed transit” area between 200 and 400 feet would be for “well-equipped vehicles,” while space between 400 and 500 feet would form a no-fly zone.

Amazon and others, however, have been butting heads with the FAA for months. Experts argue that banning commercial drone use is costing U.S. businesses millions and causing the United States to fall behind other countries that have embraced drone use. The FAA has granted 1,000-plus exemptions known as Section 333s to companies to use drones but under restrictions, including that drones must weigh less than 55 pounds and be flown only by a U.S. resident 17 or older, in daylight and good weather, below 500 feet, and in the line of sight of the pilot. All these make Amazon’s goal of unmanned deliveries that stretch many miles essentially impossible. As such, Amazon and others claim the restrictions are too restrictive and will stifle innovation.

The FAA has been working on new regulations for commercial drones for years following a federal mandate to create a plan to safely introduce commercial drones into U.S. airspace by September of this year, a deadline it didn’t meet. Until recently, final

regulations weren’t expected until late 2016 or early 2017. In July, however, FAA Deputy Administrator Michael Whitaker stated finalized regulations are expected within a year. (A 2012 federal law aimed at protecting model aircraft hobbyists prevents the FAA from implementing new restrictions for recreational drones and limits regulating operators to such restrictions as not flying drones near airports and manned aircraft. However, the FAA can impose civil fines for various infractions such as endangering other aircraft.)

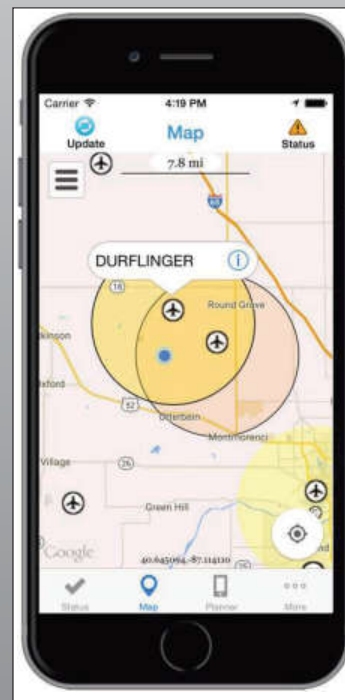
Although companies are salivating at the chance to use drones commercially, others side with the FAA in moving forward slowly to ensure safety issues are covered, pointing to concerning incidents as justification. The FAA specifically points to a sharp increase in reported drone sightings near manned aircraft this year (about 765) vs. 2014 (about 240). Other incidents such as the noise drones emit, invasion of privacy, illegal smuggling of drugs and contraband across borders and into prisons, injuries to bystanders, disturbances to wildlife, and drones being hacked haven’t done drones any favors, either. In a few cases, fed-up citizens have shot drones out of the sky, something that can draw felony charges, hefty fines, and potential prison sentences, as the FAA considers drones to be aircraft.

Many colleges are using drones for various purposes and even offering drone courses, programs, and degrees, but the University of Arkansas recently implemented policy prohibiting UAS within university air rights without approval because of public privacy concerns, including malfunctioning drones potentially causing injuries, being intentionally used as weapons, and taking video/images that violate student or employee privacy.

Other entities have taken similar measures. The Port Authority of New York and New Jersey, for example, announced in August plans to demand stores in airports cease selling drones because of community safety concerns

B4UFLY, Get The App

So you’re a drone operator itching to fly in a new location, only you don’t know what restrictions or requirements are in place for the region. No problem. The Federal Aviation Administration is working on a B4UFLY app that provides such information. About 1,000 beta testers from the public, drone industry, and government began testing the app in August. A final version expected in coming months in iOS and Android versions will include a clear status indicator that immediately informs users about a current or planned location via a smartphone’s location-based services. The app then compiles applicable restrictions and requirements. “The status indicator function considers airspace, proximity to airports, temporary flight restrictions, current law, and other FAA guidance and procedures,” the FAA states. The final version is also expected to offer an electronic notification process that would help satisfy a requirement that operators flying within five miles of an airport must notify the airport and air traffic control tower prior to operating.



Know What (& What Not) To Do

A fair amount of uncertainty exists concerning regulations, restrictions, and guidelines for commercial and hobby/recreational drones. Although commercial drone use in the United States is essentially banned without an FAA exemption, questions remain about what recreational users can and can't do with drones. Guidelines from the Federal Aviation Administration offer guidance:

Do:

- Fly a UAS (unmanned aerial system) at a local model aircraft club
- Take lessons and learn to fly safely
- Contact the airport or control tower when flying within five miles of an airport
- Fly a UAS for personal enjoyment

Don't:

- Fly near manned aircraft
- Fly beyond the operator's line of sight
- Fly an aircraft weighing more than 55 pounds unless it's certified by an aeromodeling community-based organization
- Fly contrary to your aeromodeling community-based safety guidelines
- Fly model aircraft for payment or commercial purposes

Bill 142 will continue to exacerbate this confusion," McMahon says.

All Eyes Above

Numerous people within the drone industry argue that reported drone sightings near manned aircraft have been misrepresented. Some also argue it's the irresponsible actions of a few recreational drone operators that are putting drones in a bad light. Rich Hanson, government and regulatory affairs director at the AMA (Academy of Model Aeronautics), for example, says while many believe UAS is new technology, model aircraft and UAS technology has been around for years, and hobbyists have long followed voluntary safety guidelines constantly evolving to accommodate new technologies and new modeling disciplines. AMA members, of which there are more than 80,000, know to stay clear of any manned aircraft and the importance of respecting the safety, well-being, and privacy of others, he says. "Unfortunately, the same isn't always true for the legions of new 'drone' flyers increasingly taking to the skies," he says.

Similarly, McMahon says reports of irresponsible drone use is "very concerning," but incidents appear largely tied to new drone enthusiasts or consumers who don't know where or where not to fly. "Some are flying too close to airports, too close to manned aircraft, and/or interfering with firefighting operations," he says. "These irresponsible operators aren't AUVSI members or commercial operators. They also aren't members of the organized hobbyist community, which has flown safely for nearly eight decades. But we understand that as the technology has become more accessible, information about safe flying isn't as easy to find."

To address that, the AMA, AUVSI, and FAA partnered to create a "Know Before You Fly" campaign that promotes safe, responsible flight for commercial, recreational, and civil drone use. Hanson says most people only need educational tools and a community-based

over a "growing presence of drones around the region's airports." New York Sen. Chuck Schumer, meanwhile, detailed plans to introduce an amendment to the FAA reauthorization bill, which must pass because current FAA funding is set to expire Sept. 30, that would require drone makers to integrate geo-fencing technology in models. This would essentially power down drones flying near restricted areas such as airports. In announcing the amendment, he said, "There needs to be a clear strategy to address the public safety dilemma of reckless drone use because a future drone crash could spell real trouble."

Nearly every state reportedly has contemplated a drone-related bill, and 17 have passed laws restricting usage. In California, a state bill proposed in January but eventually vetoed by Gov. Jerry Brown would have prohibited drones from flying over any private property without consent or an exemption. Predictably, the bill drew the ire of drone makers, Silicon Valley, and various aviation associations because of the economic hit they claimed it would have.

Markwalter says while the CEA supports safe, non-intrusive drone use,

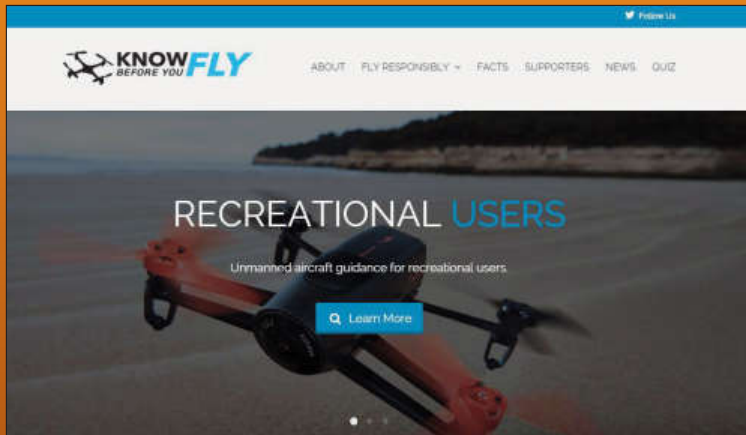
the bill would have created inconsistencies with federal law. The bill "didn't provide any commercial, research, or educational exemption," he says. "That's a serious concern that goes well beyond California's borders, as major companies are poised to invest billions in this technology and provide exciting new services to consumers." The 350-foot flight limit the bill proposed, he says, was "a purely arbitrary ceiling that doesn't recognize the realities of UAS operation" and would have led to litigation against drone users and thwarted an industry poised to deliver about 18,000 new jobs to the state and \$14 billion-plus in economic impact. "And those projections are just in the first decade once federal guidelines are implemented—a decision that could come any day now," he says. "Ill-considered laws like California's could drive jobs and innovation over the border and overseas."

Although vetoing the bill is an important step, McMahon says, an "urgency" remains for the FAA to finalize its rule on small unmanned aircraft. "There's much uncertainty about where operators should and shouldn't fly. Until the FAA acts, legislation such as SB

Know Before You Fly

There's a recognition among aviation associations, drone makers, and others that although most people operate drones safely, information about safe

"information directly into the hands of UAS operators taking to the skies," as well as those considering buying a drone.



flying isn't always easy to find. To educate newcomers to UAS (unmanned aerial system) technology, the AMA (Academy of Model Aeronautics), AUUSI (Association for Unmanned Vehicle Systems International), and FAA (Federal Aviation Administration) partnered on a "Know Before You Fly" campaign (www.knowbeforeyoufly.org) that launched in December 2014. Rich Hanson, government and regulatory affairs director at the AMA, says the goal is getting

Since the launch, numerous organizations from the unmanned and manned aviation community have signed on. Further, numerous UAS retailers, manufacturers, and distributors have agreed to include "Know Before You Fly" brochures in product packaging. One brick-and-mortar retailer is displaying material at the point of sale in all its stores, and DJI, the world's largest drone maker, has asked its sales dealers to distribute the brochures with drone equipment sales, Hanson says. To date, the campaign has 23 major supporters.

In addition to "Know Before You Fly," AMA also has a UAS4STEM (science, technology, engineering, and mathematics) program that encourages students to explore sUAS (small UAS) through teamwork, competition, and education. The program targets 11- to 19-year-olds. All students become AMA members as part of competition, and every competitor must complete sUAS ground school curriculum before participating. "UAS is an exceptional tool for teaching STEM to the next generation," Hanson says. "Model aviation serves as aviation's stepping stone and can lead to promising careers."

organization to understand where and when to fly safely. "More education, not more regulation, is the key to safe and responsible flying," he says. The FAA also instructs operators to follow safety programs from community-based organizations such as the AMA or follow its proposed rules for commercial drones. "Newcomers to UAS technology would no longer fly without any supervision or education, as is happening now," McMahon says.

Beyond providing education, McMahon and Hanson say the FAA could better utilize its power to impose civil fines (up to \$25,000) against those violating existing regulations. "There's no doubt that there are some drone incidents that represent actual safety concerns, and more needs to be done to address those," McMahon says. This includes increased diligence in enforcing existing laws and regulations. Still, the FAA has only levied a few fines to date, he says.

"That needs to change. One place to start is by working closer with local law enforcement" to identify and investigate reports of unauthorized drone operations, he says. Though difficult, "there's little hope of understanding what is occurring in these incidents unless regulators and law enforcement agencies dedicate the resources necessary to find out what really happened," he says.

Living With Drones

Although currently only recreational users can operate UAS in the United States, this is enough to feed a consumer market that could reach \$250 million by 2018, Markwalter says. If the FAA completes line-of-sight rules for commercial operators in the near future, CEA research projects another potential \$200 million in growth. As development of sense-and-avoid technology continues and FAA rules foster BLOS (beyond-line-of-sight) flights, the U.S. drone

industry could become a \$1 billion market, he adds.

Wheelock similarly says that despite restrictive regulations, the commercial drone market has and will continue to grow for the foreseeable future. Companies are already in the R&D stage for producing products and are positioning themselves for when regulations are more liberal and accommodating. Blades predicts the FAA will have rules for sUAS weighing less than 55 pounds within two years and a BLOS operating construct within five. It may take several more years of testing before parcel delivery becomes a factor in the market, he says. "There are many other issues, but the main point is that the manufacturers and companies that produce drone software are actively working to solve these issues so they can provide solutions to the FAA rather than waiting for bureaucratic decisions that may not provide the best or safest results." ■

CPU

Game Of The Month

Yeah, we know you have blogs to post, video to encode, reports to write, and code to compile. We do, too, but you have to take a break once in a while (and maybe blow some stuff up). That's why each month we give you the lowdown on what to expect from the latest interesting games.



As we went to press, *Metal Gear Solid V: The Phantom Pain* seemed like Hideo Kojima's swan song, at least with regard to Konami's stealth franchise. Having played a few of the previous games, this one has the undeniable ring of a magnum opus.

Although longtime fans bristled at David Hayter's replacement by Kiefer Sutherland as the voice of Snake, Sutherland's "Bauer" Snake maintains the character's gruff demeanor. There are numerous callbacks and nods to previous (and future) *Metal Gear* games, as well as a cast of several familiar characters. Despite this, new players don't need to have played any of the previous games to get a handle on the plot. The events of *MGSV:TPP* pick up in the middle of the *Metal Gear* chronology. Following a nine-year coma that results from a helicopter crash at the end of *MGSV: Ground Zeroes*, Snake is tasked with rebuilding Mother Base and recruiting a new private army called the Diamond Dogs, all while tracking down the nefarious XOF, Skull Face, and Cypher.

In the core game, Snake performs various infiltrations, extractions, assassinations, and sabotage missions in an open-world sandbox throughout Afghanistan and the Angola/Zaire border region in Africa. You have a handful of objectives for each mission but are entirely free to approach the situation however you see fit. This freedom is the game's biggest strength. As you add more weapons, gadgets, vehicles, and upgrades to your arsenal, your list of creative ways to get out of a jam balloons. But as you progress, the enemy learns your favorite tricks and deploys upgrades of its own, such as helmets, body armor, gas masks, night-vision goggles, and more, to keep you on your toes.

The best upgrades you can unlock are your Diamond buddies. D-Horse makes quick work of traversing Afghanistan and Africa's vast wildernesses. D-Dog is your one-eyed canine companion who excels at recon and can even take out enemies. The D-Walker is a bipedal robotic walker that you can ride into battle. One of the best pals you

Metal Gear Sandbox

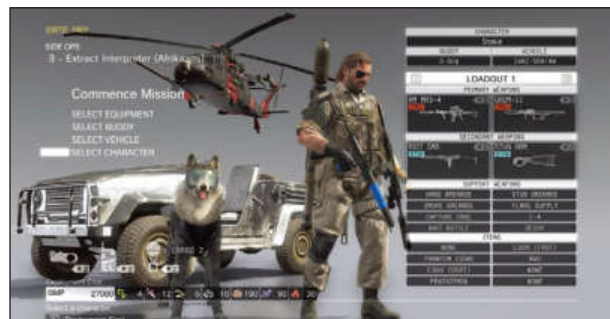
BY ANDREW LEIBMAN

\$59.99 (PC, XOne, PS4) • ESRB: (M)ature
Konami Digital Entertainment • www.konami.com

can partner with is Quiet, a mute sniper who can take out an outpost full of enemies while you sneak around collecting resources and intel.

You'll end up sinking a considerable amount of time into managing and constructing Mother Base. This aspect of *MGSV:TPP* feels like a mini game, but it's surprisingly deep. Everything you do on Mother Base is fueled by money, or GMP. You can earn it by airlifting vehicles and weapons and then selling them, sending your recruited soldiers on missions, finding rough diamonds, or selling your collected resources. GMP is used to fund your activities and pay for upgrades. Although the pace is a bit slow and the menus clunky, playing the Mother Base side of *MGSV* really pays off when you're on the battlefield. Remember those enemies with helmets and night-vision goggles? Your Diamond Dogs can be dispatched to destroy the respective storage sheds, making your headshots and night infiltrations much more reliably successful.

This game rewards stealthy players who can accomplish their goals without disturbing the enemy. But there's something to be said for setting off a series of strategically-placed C4 charges, calling in a gunship for cover fire, launching an aerial bombardment, and whipping out a rocket launcher just to nab a detained prisoner. If either option—or anything in between—sounds like fun to you, then you'll love this game. ■



MAD MAX

Coming on the weathered, dirt-caked heels of this summer's reboot sequel bombastic blockbuster "Mad Max: Fury Road," Avalanche Studios' Mad Max has the simple task of taking the baton from what is arguably the best pure action movie of all time. No pressure, right?

When "Mad Max" auteur George Miller himself can't decide where "Fury Road" fits in the franchise's continuity, there's little reason to squabble over what exactly to call the videogame, so here are the facts: You play as everyone's favorite post-apocalyptic antihero, Max Rockatansky (who in the game bears little to no resemblance to either Mel Gibson or Tom Hardy). Geographically speaking, we're in roughly the same neighborhood of the Wasteland as "Fury Road," with Gas Town featuring prominently. Antagonistically speaking, you square off against one of "Fury Road" big bad Immortan Joe's psychotic sons and his legion of War Boys, so the game fits comfortably in the "Mad Max" universe without suffering the plagues and pitfalls of being a straight adaptation.

The game begins much like "Fury Road," with a War Boy patrol falling upon Max and his beloved Interceptor. Stripped of his possessions and left as crow food, Max begins his quest for vengeance. In short order, he happens upon Chumbucket, a Cult of the V8 fanatic who is an amalgamation of Igor, Gollum, and even a little bit of Ephialtes from "300." Chumbucket is your faithful sidekick throughout the game, repairing your new set of wheels (the Magnum Opus, per our chum Chum, but it could just as easily be dubbed Magnum MacGuffin), upgrading it, riding—but not firing—shotgun, and offering guidance. The only cost of having such a useful companion is having to suffer through his shtick of religious fervor, which, trust us, gets old by the third or fourth mission.

First and foremost, Mad Max is a sandbox game full of actual sand. The Wasteland that Avalanche Studios has created is beautifully bleak, and the studio took the time to get all the little details right, adding effects

Grand Death Auto

BY VINCE COGLEY

\$59.99 (PC, XOne, PS4) • ESRB: (M)ature

Warner Bros. Interactive Entertainment • www.madmaxgame.com

such as heat haze and swirling sandstorms, which truly immersed us into the game. Day/night cycles are more effective than you might think, too, as the countryside, such as it is, springs to life when the sun goes down. Flickering flames of the War Boys' camps dot the horizon, leaving a feeling deep in your gut that the fight for survival is a never-ending struggle. In short, the world itself is perfect.

Gameplay is split almost evenly between vehicular combat and a third-person beat 'em up. The former manages to reproduce fairly well the visceral intensity present in all but three minutes and 17 seconds of "Fury Road." The latter takes a comic book page from another WB Interactive property, Batman: Arkham, although the mechanics here are rather basic, and that extends to the game's boss fights, somewhat regrettably.

In a world where automobiles are literally a religion, the game's selection of cars and the extensive catalog of upgrades you can add to the Magnum Opus are impressive, and it's fun to unleash your ever-expanding arsenal on War Boy vehicles. However, the actual process of acquiring the necessary resource (scrap, and only scrap) to purchase upgrades is tedious to say the least. No one wants to wander this world scavenging junk like a post-apocalyptic garbage man, but that's exactly what Mad Max makes you do. The juxtaposition of this chore with the game's high-RPM combat elements only exacerbates the feeling. Let's put it this way: There's a reason you don't see the Doof Warrior in "Fury Road" lay down his flamethrowing guitar to do his taxes.

Mad Max is a grim and gritty game that you can spend many lovely days playing. However, it doesn't quite belong among the vanguard of open-world games, such as Grand Theft Auto or Red Dead Redemption, or even among outstanding newcomers, such as Witcher 3 or Metal Gear Solid V (which is our October Game of the Month). If you can learn to live with some of the rust, you'll find that most of Mad Max is shiny and chrome. ■





Most people who are acquainted with the world of Shadowrun probably know that it started out as a pen-and-paper RPG, sort of like a cyberpunk version of D&D. But like many people, I didn't come into contact with Shadowrun until 1993, when Beam Software and Data East released a Shadowrun game for the Super NES. Within hours of turning the game on, I was hooked.

For those of you who may not be familiar, Shadowrun takes place in the future (often set within a few years of 2050), where governments have largely given way to massive global corporations that control nearly every phase of life. Corporate computer networks are everywhere, and the ability to hack them is a much-sought-after skill in the criminal underworld, for purposes of corporate espionage and (of course) straight-up larceny. But there's another important aspect to the world of Shadowrun—magic has come back into the world, accompanied by several demi-human races (elves, dwarves, orcs, etc.), and far below the glamorous steel-and-glass towers where the Haves live, the streets are a sci-fi/fantasy battleground.

Shadowrun: Hong Kong (available in the Steam store or on GOG for 20 bucks) is the third installment in a series of Shadowrun titles developed and self-published by Harebrained Schemes, with help from Kickstarter, that began in 2013 with Shadowrun Returns. Unlike the 2007 PC and Xbox Shadowrun FPS, Shadowrun Returns takes players back to the RPG elements of the Shadowrun world that are so compelling: cool settings, interesting characters, flexible character design and development, a great story, and simple yet deep turn-based combat.

In Shadowrun: Hong Kong, you play the role of a character who grew up as an orphan on the streets of 2040's Seattle but was taken in by Raymond Black, who became a father to you. You left your foster dad and your best

Something Old, Something New

BY CHRIS TRUMBLE

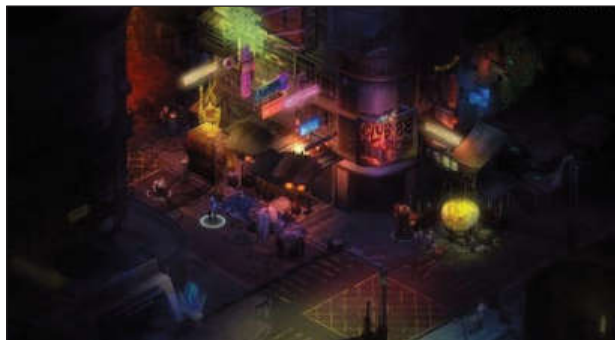
\$19.99 (PC) • ESRB: No rating • Harebrained Schemes
www.harebrained-schemes.com/shadowrun/hongkong

friend Duncan (also taken in by Raymond during childhood) to seek your fortune and ended up running afoul of the megacorps and spending several years in prison. Just prior to the start of the game, your character is released from prison and shortly thereafter receives a message from Raymond: He needs your help and summons you to Hong Kong.

You use the funds that came along with the summons and travel to Hong Kong, where you are greeted by Duncan, but not by Raymond, who was supposed to meet you. Duncan, who in the interim has become an officer of the law, informs you that Raymond has disappeared, and so along with his partner, you set off to find out what happened to him, a quest that very quickly plunges you neck-deep into Hong Kong's seedy underbelly. You and Duncan are forced to erase your legal identities in order to evade certain destruction, and you subsequently have no choice but to become Shadowrunners to survive and to continue your quest to find Raymond.

The game's simplistic graphics are a throwback to old-school RPGs, but the music and sound effects are modern and accomplished, helping to set a compelling tone right from the start. The game lets you be just about any type of Shadowrun character you'd like, either by selecting a stock class or by creating a completely custom character, and you progress by completing missions and surviving in Hong Kong's mean streets. You also get an upgraded version of Harebrained Schemes' level editor that lets you create your own Shadowrun adventure, which you can share by uploading to Steam.

Whether you started out playing the pen-and-paper game, reading the numerous novelizations, or (like me) playing the early Shadowrun videogames, Shadowrun: Hong Kong will slake your thirst for one of the coolest fiction worlds ever created. Both thumbs way up. ■



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Q&A With Dr. Michael Liehr

Photonics, Shrinking Chips & Extending Moore's Law

In July, the IBM Research Alliance (IBM, Samsung, and GLOBALFOUNDRIES) unveiled the semiconductor industry's first 7nm node test chip with functioning transistors. Although actual chip production could still take years, industry insiders almost immediately praised the alliance's accomplishment in extending Moore's Law at least a couple generations. Others noted the alliance's use of new EUV (extreme ultraviolet) lithography techniques and SiGe (silicon germanium) material. Also noteworthy is the alliance's partnership with SUNY Polytechnic Institute's Colleges of Nanoscale Science and Engineering in Albany, New York, where the 7nm breakthrough occurred in the SUNY Poly chip foundry. Dr. Michael Liehr essentially oversees this foundry.

In addition to his duties at the SUNY Poly chip foundry, Liehr is Poly's executive vice president of innovation and technology and vice president of research, and he recently became CEO of the new SUNY Poly-led AIM Photonics (American Institute for Manufacturing Integrated Photonics). Funded through federal, state, private, and public funds, the institute's research will explore integrating photonics components "to revolutionize computer chips, making them faster, smaller, and more reliable." We spoke with Liehr about the 7nm feat, Moore's Law, and photonics fresh off his participation in the official announcement for AIM Photonics alongside U.S. Vice President Joe Biden, New York Gov. Andrew Cuomo, and other officials. For our full interview, go to www.computerpoweruser.com/18381.

Q : What does your involvement with the IBM Research Alliance and its success producing 7nm node test chips with functional transistors personally mean to you?

ML : I've been in this industry, I hate to admit it, 30 years or more. I feel a tremendous amount of pride, even though I know I'm a little cog in a very, very big engine that has really pushed forward more and more, for obviously more than 30 years. Semiconductor research has really enabled this industry to influence the way we live in such a profound way. The Internet, cell phones, you name it. I'm surrounded by technology that's all enabled by what the semiconductor industry has been able to do.

This relentless making of things cheaper by 25% or so every year has gotten us from a point from when IBM in the old days said, "I think there is a world market for maybe five computers," to a point where everybody carries multiple computers much smaller than what they could 30 years ago. Again, as



one small, little piece in a very significant community, we have collectively worked to make that happen. I feel very good about what it has done to the overall quality of life.

7nm is just a proof point that Moore's Law is not dead. A lot of skeptics—and by the way, I'd have to include myself in this—believe Moore's Law is getting

harder, not technically, to be very clear, but financially. It took more than just one company to take that next step and demonstrate absolutely that we've taken it; it's a group of companies that are pushing the envelope of Moore's Law and continue to push and have a firm belief we can continue to do that. Again, that makes me feel very good. It also makes me feel good as a former IBM employee working at SUNY Poly to have been part of this through the development activities we have here, which include companies like Samsung, GLOBALFOUNDRIES, as well as others. We've worked with all these companies, as well as IBM, for a long period of time to now be involved from this university point of view. That also makes me feel very good because it is testimony to this public-private relationship model that certainly IBM has embraced and obviously SUNY has in particular been advocating.

Q : You noted in a previous interview that Moore's Law has become an economic law vs. one that strictly concerns physics. Can you explain this?

ML : There was a period of time when Moore's Law was really more defined as a linear shrink of the modeled dimension of its shape. And that's something that was certainly true in the 1970s, to a large extent in the 1980s, and it had a lot to do with a person, Bob Dennard, who came up with scaling laws for standard CMOS that more or less said, and I'm paraphrasing obviously, that as long as you come up with better techniques to do your lithographic exposures that allow you to shrink every two or three years every feature on your chip by a certain percentage, Moore's Law will

Our main problem is cost reduction in making chips smaller. People used to think of it as just size, but it's really cost. If you can more or less spend the same amount of money to build the next-generation chip, but the chip is only half as big, then you have substantial costs to take on. If you can manage this tradition every couple years, that's where the 25% costs tacked on per year comes from. If you're losing the ability to do that lithographically, you have to get very complex. People have obviously found ways around not being able to use the next lithography generation, called

same amount of costs or your individual chip cost has gone down by 25%. And that's when you and I buy it, when we buy a cell phone. Tremendous capability for just about the same amount of money. When computers were \$2,500, very few people bought them. Now that they're \$300 to \$500, everybody buys them. The threshold that you have to get to all of a sudden becomes pervasive, and the semiconductor industry has been very good at that. And Moore's Law and the cost that it takes to take the next step is what might interfere with that at some point—it probably will—but the question really is when.

If and when EUV is real . . .
then we take another step,
and we're back on the
Moore's Law treadmill
at least for a little while.

Q : Along with EUV, SiGe was used in developing the 7nm node test chip. Characterize the significance of exploring new technologies, techniques, substances, etc. in chip R&D.

ML : I mentioned the 193nm wavelength. With a lot of tricks, people were getting it down to being able to print features in the order of 40 or 50nm. Below that, it got very expensive. In order to continue stepping down, something very different was needed. Basically, EUV is a soft X-ray. The EUV lithography machine is a technological marvel. If you've ever seen one of these things, besides the price tag of course, it's an amazing piece of equipment that's still boggling my mind every time I have a look at it—that a piece of machinery with this many parts continues to work and work the way it's been portrayed. But it took them 20 years. Again, all that obviously needs to make financial sense to a company like ASML (the EUV machine's manufacturer). It needed a lot of help, so companies like Intel, TSMC, and Samsung invested billions of dollars in this company in order to take this next step. Now why did they do this? Because in order for their businesses to continue, they require Moore's Law to continue going. They are at the leading edge. They make more money at the leading edge vs. the trailing edge. So they would like to keep it going, and therefore they're willing

continue. This unfortunately changed in the late 1990s, and people had to start putting all kinds of new materials in place, as well. Eventually, it hit a physical boundary where one of these dimensions happened to be the insulator thickness. You have to have a gate that switches a current on and off, and if that gate is sitting on an insulator that is so thin that it leaks, you lose the ability to switch it adequately, and if you can't scale this, you can't scale the rest of it either.

That's when things got really complicated and folks had to introduce new materials. The lithography was failing. The tools we used to use, it's ultraviolet light with a wavelength of 193nm, and we're trying to build features these days that are 7nm. So there was a real problem in the availability of the next lithography tool. It took 15 to 20 years to get EUV (extreme ultraviolet) lithography to a point where it's a very serious contender, but it's still not quite ready for prime time, and it's very expensive.

computational lithography, where folks just simulate the hell out of what you're able to do with light to still make it print features much smaller than the wavelength, but that came out of the costs. It is no longer true that you more or less spend the same amount of money or maybe 20 to 30% more from generation to generation and get this big-bang type of cost benefit by shrinking the die. All of sudden the cost per generation went up more, and the shrinking didn't take place at the same level, and now comes the economic equation. This is all what took place in the early 2000s, and we're suddenly living it now.

If and when EUV is real, and I would personally believe that is very soon, maybe in the next couple years, then we take another step, and we're back on the Moore's Law treadmill at least for a little while. But it is an economic model at the moment—what people could see is the benefit of more capability for either the

to make that investment in this tool that will allow them to take the next step.

Moore's Law as we know it will not go for that much longer. I'm not here to predict how much longer, it will go for a little longer, but it won't go indefinitely. There are other approaches that people are taking. SUNY Poly just won a very large federal award. This is one of the manufacturing initiatives that President Barack Obama called into being two or three years ago, and

the chip here, fully packaged, can do 500Mbps. You could take the entire Library of Congress and shift it from coast to coast in 20 seconds. I couldn't help myself but to add, "But would you really want to?" and he said, "Well, if you can't sleep at night, I guess." But joking aside, that sort of bandwidth in instances, say, like when you have a Facebook page and when you log onto your page, it gets built on the fly. So you go into some big

weighs less. Fiber is glass. It doesn't weigh as much as copper.

The DoD (Department of Defense), which is funding this photonics manufacturing initiative, has obvious implications. If you have a fighter plane, obviously sending a lot of the weight with cabling in it isn't what it wants. It would rather use the weight for other purposes. So in very simple terms, that's the reason the DoD is interested. It also runs data centers, and it needs the energy savings. And last but not least, it's because of the speed and is another way to get Moore's Law going. You can always trade off speed against costs in this game, so I stay at the same speed and take my costs down. So it will keep Moore's Law going, and we'll continue to call it 'Moore's Law,' but as I said, it's an economic law, and at the end of the day, whichever thing we have to throw at it, we'll throw at it because it keeps our industry going.

Q : How far can Moore's Law be extended, and what does pushing it out as far as possible mean to consumers long-term?

ML : I can give you a little anecdote at least. I used to be in IBM at the T.J. Watson Research division in Yorktown Heights, New York. I worked for a short period of time as a technical assistant to a guy who sort of ended up running it. There was an annual thing the division did at the time called the 10-year outlook. It has it still, but it's called something else. But basically you get the smartest people you can together to design what the world will look like 10 years from now. So the first thing we did was to see how good the guys who did this 10 years ago did and see how many of the things they predicted were correct. You'd be surprised; 30% about. So some of the very smartest people we could come up with, and they missed more often than they could get it right. So the conclusion from this in terms of how to predict the future and so on, what you have to do is continuously adapt as you get more data. And even looking out a few years is nearly impossible to get right. ■



In this photo from IBM, Dr. Michael Liehr (left) of SUNY Polytechnic Institute's Colleges of Nanoscale Science and Engineering and Bala Haran of IBM Research inspect a wafer made up of 7nm node test chips at research facilities located at SUNY Poly in Albany, New York.

the one we won is on integrated photonics. So this is another way to sort of extend the "put more capability on a chip at reduced cost," which is really what Moore's Law is. Here, the concept is basically replacing wires with fibers. If you look at your home and your Internet connection, in the old days it was twisted wire, now you probably have CAT 4 cable going into your house, and you can do multi-megabits per second depending on your carrier. If the carrier upgraded to fiber, I'd be able to download 100Mbps, not 2Mbps.

It's funny, we had the vice president at a kickoff, and I mentioned to him

data center and it sucks all the data it needs from multiple locations and puts this page together for you. And we've gotten used to seeing this sort of service from anywhere at any time. And we need technology like that. So the big difference between fiber and wire is speed. The speed can be a lot higher. The second difference is that fiber doesn't heat. A wire warms up, and that's wasted energy. These data centers, they consume like 2% of the United States' entire energy consumption at the moment. That can't go on much longer, either. So fiber has much lower power consumption. And lastly, fiber

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lanfest.intel.com

10.09-11-15

SanDiegoLAN.net
2015 Fall
LAN-A-THON
San Diego, CA
www.SanDiegoLAN.net/LANaThon.html

10.16-17.15

BearTrap Gaming LAN
Orem, UT
www.beartrapgaming.com

10.16-18.15

The GXL: Titan 2015
Oaks, PA
www.thegxl.com

10.17-18.15

FortLAN 7
Fort Wayne, IN
www.fortlan.org

10.17.15

Oklahoma
Gamers Group
Oklahoma City, OK
www.okgg.org

10.17.15

Willamette Valley
Gamers LAN
Eugene, OR
www.wvgamers.com

10.23-25.15

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Waterloo, ON
lantastic.ca

10.23-24.15

Legendary LAN
Fall 2015
Harrisburg, PA
www.legendarylan.com

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LANified! 23:
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11.06-08-15

Maryland LAN Gamers
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www.marylandlangamers.net

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PDXLAN Charity Event
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pdxlan.net

11.21.15

Oklahoma Gamers Group
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www.okgg.org

11.21.15

Willamette Valley Gamers LAN
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www.wvgamers.com

11.28-29.15

LANified! 24:
Rumble in the Rift
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www.lanified.com

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www.thepromisedlan.weebly.com

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Oklahoma
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Prattville, AL
www.thepromisedlan.weebly.com

01.15-17.16

FADECON
Garland, TX
www.fadecon.org

02.18-21.16

PDXLAN 27
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pdxlan.net

04.15-17.16

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Q&A With Joseph Evanish

PNY's Storage & Memory PM
Talks DDR4 & Anarchy

Q : It seems like PNY waited a bit longer than some companies to jump on the DDR4 train. Why?

JE : PNY wanted to be able to offer a portfolio of product that suits the needs of all customers. Instead of solely working on a DDR4 concept to please a technology that the market hasn't quite caught up to yet, we decided to re-engineer our DDR3 line to accommodate DDR4 as well. Hence, the Anarchy and Anarchy X heat spreader technology is applicable to both. This took a bit longer than expected, but the end result maximized performance for our DDR3 customers as well as our DDR4-seeking customers.

Q : Now we've seen your Anarchy X kits, and they look and perform great. What is different now vs. Intel's X99 launch that made it the right time for PNY to unveil its DDR4 line? Do you see the Z170/Skylake launch as the key to making demand for DDR4 more mainstream, or are there other factors at work?

JE : We were targeting our DDR4 launch to coincide with a more mainstream DDR4 chipset launch, which is why we chose to release our Anarchy X line just before the official release of the Z170 chipset. In addition, the new chipset is now the only chipset with official support for overclocking, which shows that the industry is becoming much more aware of tuning and is taking it more seriously. Simply put, it's the right time to get in the game.

Are there other factors in play for making DDR4 more mainstream? Sure. But the Skylake launch is key in elevating DDR4 to the mainstream spot.

Q : You guys have been establishing XLR8 as your enthusiast-grade memory,



SSDs, and graphics cards for many years now. How would you say Anarchy X is distinct from your XLR8 products? Also, will Anarchy X remain a memory-only brand, or can we expect to see it spread to other component categories, as well?

JE : PNY is actually in the process of an XLR8 rebrand, which started with the launch of our Anarchy and Anarchy X PC memory. XLR8 has evolved from a PNY sub-brand into a gaming badge, something our gaming and enthusiast customers can resonate with to easily identify high-performance PNY products designed especially for them. Consumers will also see a new, edgier packaging design. We started with PC memory, but in the next coming months it will expand to solid-state drives and graphics cards.

Anarchy and Anarchy X is the identity we gave our enthusiast-grade PC memory for mainstream and extreme gamers, respectively. We wanted to give our enthusiast line a more purposeful meaning. Our new Anarchy line acts the part for sure and is evident in the performance numbers

achieved, but it also needed to sound the part. PNY Anarchy is something that our team came up with that really speaks to the aggressiveness of gameplay, the ruggedness of the memory itself, and the unique style that is demanded with each custom build. Will Anarchy be used in other component categories? Hmm . . . I guess I'd have to say—time will tell!

Q : Anarchy X kits currently come in 2,666MHz and 2,800MHz varieties. Does PNY have plans to release kits rated for 3,000MHz and up?

JE : We definitely have plans for speeds of 3,000MHz and higher to specifically target our extreme gamer customer base. Early 2016 will be an exciting time for PNY PC Memory Division!

Q : Love the new Anarchy X heat spreaders! Can you talk about their design and what went into their creation?

JE : Thanks! When creating the new heat spreaders, the first point we focused on was that they had to dissipate heat better than the conventional heat spreader. Our ultimate goal was to provide our loyal customers with a product that outperforms. We made sure that the design not only distributed heat evenly, but also dispersed the heat through the lengthy fins. By doing so, Anarchy X is effectively a heatsink *and* a heat spreader, allowing us to maximize the cooling process. Once we nailed down the functional purpose, we could then focus on the design of the product. The goal was to make sure that the look of our product complements the aggressive looks of our user's rigs, with their choice to customize in either red or blue clip designs. That's why Anarchy X looks fierce, edgy, and downright unruly! ■

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